making sense of heritage

The Butcher Wheel Arundel Street, Sheffield

South Yorkshire Industrial History Society Journal

Ref: 77640
July 2016

wessexarchaeology

For *South Yorkshire Industrial History Society Journal*

THE BUTCHER WHEEL, ARUNDEL STREET, SHEFFIELD

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and illustrations by Rob Goller

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Abstract

The conversion and reuse of the Butcher Wheel, a former Sheffield cutlery works on Arundel Street, included a programme of archaeological building recording and detailed analysis of its evolution and operation. The works, which grew as the family business of William and Samuel Butcher at the start of the 19th century, rapidly expanded in size and output making it by the 1860s one of the principal manufacturers in the city. This growth coincided with the demand for knives and edge tools for the overseas market, initially in the colonies and then during the settlement of the west coast of America.

The standing buildings comprising the Butcher Wheel today were investigated in advance of, and during, the redevelopment of the site by J. F. Finnegan between 2005 and 2006. The archaeological investigations identified 12 broad phases of alteration and change, including hand forges, grinding workshops, assembly shops, offices, packing rooms, warehouses and a caretaker's house. This publication sets the works in its historical context within the Sheffield metal trades, and examines the techniques and processes utilised by the cutlery industry.

The Butcher Wheel contained some of the only surviving upper-floor grinding workshops in Sheffield, which were surveyed and archaeologically excavated as part of the project. Three principal designs of trough were identified, which would have required a substantial investment in the construction of strong fireproof ranges, more in keeping with the cotton mills located elsewhere in Yorkshire and Lancashire. Motive power was provided by two steam engines, which were replaced in the 20th century by electric motors.

Acknowledgements

This volume is the result of the hard work of many individuals who are thanked for their efforts and enthusiasm throughout the life of the project. It was undertaken by a dedicated team including: Dr Mark Douglas, Alex Rose-Deacon, Tegwen Roberts, Neil Dransfield, Chris Breedon, Chris Swales, Simon Jessop, Daniel Tucker and Steve Duckworth, who also prepared a draft interpretation of the site. Project management was by Oliver Jessop.

The University of Sheffield, particularly Professor John Moreland, have been instrumental in moving this project forward and, together with Nick Gillott of J. F. Finnegan, they are acknowledged for funding this publication. The South Yorkshire Industrial Society is also thanked for including this work as part of their publication series.

Race Cottam Architects and the team at Finnegan's are thanked for their help during the construction programme, which was at times very complex, requiring careful project management.

Geoff Tweedale was very generous with providing copies of historic material, and for discussing ideas about the background history to the works (much of it unpublished). Robin Wiltshire and his colleagues at Sheffield Archives, and Sheffield Local Studies have been extremely helpful with locating archive material and historic images; Pat Dallman (Local Studies Library) and Tim Knebel (Sheffield Archives) are thanked for help with reproduction of Figures 5, 7–9, 13–14. Lucy Cooper from Weston Park Museum has searched their collections for relevant material; Julie Taylor is thanked for facilitating reproduction of the Wade and |Butcher printed wrapper (Fig 10). Christine Ball and Ken Hawley of the Hawley Collection at Kelham Island Industrial

Museum, have been a wonderful source of information and guidance, particularly in regards to the subtleties of the Sheffield metal trades. Dr Joan Unwin of the Company of Cutlers and Dr Victoria Beauchamp who surveyed many sites in Sheffield during her PhD research, have both been very generous in their advice regarding the growth of the metal trades, and they are thanked for their help.

Dinah Saich of the South Yorkshire Archaeology Service has been a constant source of help, not only providing access to background material, but keeping a watchful eye on the site works and post-excavation analysis.

Nick Wright and his team, many of whom formerly spent years grinding within the workshops at Butcher Wheel, are thanked for sharing their memories and helping to make sense of the ephemeral remains left behind at the time of the archaeological survey.

Nicola Wray and Colum Giles are thanked for discussing aspects of the *One Great Workshop* survey undertaken by the Royal Commission on the Historical Monuments of England during the 1990s.

The staff and students at Freeman College, which now occupies many of the former workshops, are acknowledged for their encouragement for the project and for ensuring that the buildings are maintained as a living and working community continuing in the tradition of the Sheffield metal trades.

The publication project was managed by Chris Moore (Wessex Archaeology); James Thomson (Wessex Archaeology) helped to identify archive material; and the illustrations are by Rob Goller (Wessex Archaeology).

Editing of the text has been undertaken by Professor Dawn Hadley of the University of Sheffield, who is thanked for her comments and advice; and by Chris Moore and Philippa Bradley of Wessex Archaeology.

Chapter 1 – Introduction

Project Background

[Fig 1]

This publication describes the archaeological recording and investigation of a former metal trades factory, the Butcher Wheel, known today as the Butcher Works. The complex is a designated heritage asset, listed Grade II*, that is located in the Cultural Industries Quarter Conservation Area (CIQ) (Fig.1). It represents one of the largest and least-altered examples of a courtyard factory, of a type once common within the city. The site comprises over a dozen distinct buildings constructed at different dates, each of which has been reconfigured to form four ranges of interconnected buildings extending to either three, or four storeys surrounding an enclosed yard.

The Works originated as the cutlery, edge tool and file-making factory of William and Samuel Butcher. Commencing with two small plots on Eyre Lane in the early part of the 19th century, the Works had rapidly expanded to cover six plots by the 1870s following a rapid growth in sales in America and the Colonies.

The archaeological and historic significance of the buildings was initially established by the former Royal Commission on the Historical Monuments of England (RCHME) in 1995 as part of the *One Great Workshop Survey*. This established the Butcher Wheel as one of the key industrial sites in the region, resulting in further archaeological recording during the redevelopment of the buildings into apartments by J. F. Finnegan Ltd between 2005 and 2007. Archaeological Research Consultancy at the University of Sheffield (ARCUS) completed the standing building survey and maintained an intermittent watching brief during the construction programme.

The archaeological recording was a fundamental aspect of the redevelopment, providing information that directly influenced the construction programme, thus ensuring that as much as possible of the historic structural fabric could be retained. The ARCUS survey added to the initial work by the RCHME and provided new evidence for the evolution of the buildings, and a greater understanding of the operation of the factory and the individual industrial processes.

Setting and layout of the Works: Topography, Geology and Urban Character

Topography and Geology

The underlying solid geology of the Arundel Street area comprises the Pennine Lower Coal Measures Formation of the Westphalian A sequence, including Mudstone, Siltstone and Sandstone (British Geological Survey digital data 2011). The works is positioned on a linear terrace that runs along the west side of the Sheaf Valley. The site entrance opening onto Arundel Street lies at 66m Ordnance Datum, with the courtyard gradually rising towards the north. The courtyard is centred on NGR SK 3547 8687.

Urban Character

Until the late 18th century, the area surrounding the site had a rural character, being defined by the enclosed field system of Alsopp Farme (Alsop Farm). This was recorded by John Harrison during his survey of Sheffield Park in 1637 (Scurfield 1986, 163–4), who listed the farm as demesne land of Sheffield Manor let to tenants at will. It lay just within the boundary of the medieval deer park.

In the 1770s, the Norfolk Estate commissioned the renowned architect James Paine to prepare plans for an exclusive residential district aimed at the increasing numbers of

wealthy cutlery manufacturers within Sheffield. This also appears to have been an attempt to promote the status of the city in light of similar contemporary developments in London, Edinburgh, Bath and Buxton. In 1775 plans were drawn up by Paine for the new layout (Fig.2), which adopted a grid formation with a hierarchy of streets comprising principal boulevards and ancillary streets for mews and service uses. His approach was similar to the designs implemented by James Craig in the Edinburgh New Town (Cruft and Fraser 1995), but without the use of formal squares. The streets were staked out on the ground, thus establishing a new infrastructure; however, no actual construction began and Paine's vision for rows of imposing townhouses was never realised (Harman and Minnis 2004, 135–6).

[Fig 2]

Unfortunately, there was no interest in the prestigious residential scheme and by the 1790s cutlers were granted permission for building smaller houses. The original development included a covenant on the land that restricted 'offensive trades' (Harman and Minnis 2004, 136), although this had been lifted by 1800 and, along with construction of new houses, the culters built adjacent workshops. The Fairbank rate books document the speed of this expansion, and by the 1850s the area was an industrial district similar to many other areas of the city with workshops, yards, stables, shops and dwellings, set apart by its unique 'grid iron' street pattern.

Site layout

[Fig 3]

The Butcher Wheel forms a corner plot with Arundel Street to the south-east, Brown Lane to the north-east and Eyre Lane to the north-west (Fig.1). For consistency between the different stages of survey, the RCHME convention for the reorientation

of the site was maintained, which assumes that the street pattern is orientated west-east; thus Eyre Lane is to the north, Brown Lane to the east and Arundel Street to the south (Fig. 3). In this publication, the orientation of buildings within the site is described with reference to the site grid adopted throughout the recording work by RCHME and ARCUS; orientations of the site as a whole and in relation to other locations in Sheffield are given with reference to the Ordnance Survey grid.

The extant buildings represent the culmination of property acquisition and episodes of construction between the 1820s and 1870s. The resultant building form is a courtyard with a central brick chimney, and several projecting ranges, that can be subdivided into 15 building components (Fig. 3, A–Q).

In the first half of the 19th century, the Works was accessed from Eyre Lane via a pair of entrance passages. The western archway opened onto a narrow passage (called Fourteen Foot Lane), providing a public right of way through to Arundel Street. The Butchers, however, had obtained a right of access to the lane and by the 1870s it was incorporated within their expanding works, with accesses being transferred to Arundel Street from the south.

Archaeological Recording Programme

The recognition during the 1990s that the Butcher Wheel was a significant metal trades building directly influenced its subsequent preservation and sympathetic conversion into apartments. As part of the planning submission, an assessment was commissioned to examine the previous archaeological surveys (Wray 2000; Beauchamp 1996) to establish whether any additional recording would be necessary. The assessment (ARCUS 2005a) concluded that whilst the broad historical development of the works was understood, a detailed phased interpretation had never

been undertaken. This culminated in a phased programme of archaeological recording (ARCUS 2005b) to address any gaps in the archaeological record.

Methodology

The archaeological programme was staged, with phase one comprising additional archive research, and the metric survey and photography of each room in turn. Phase two comprised an intermittent structural watching brief during the construction programme to document previously concealed sections of building fabric. The archaeological excavation of three different styles of grinding trough was also undertaken. The final phase of the archaeological programme comprised analysis and reporting leading to this publication.

Regeneration & repair programme

Regeneration of Sheffield's Industrial Districts

The Sheffield Development Corporation (SDC) was created in 1988 by the Secretary of State for the Environment to oversee the urban regeneration of the Lower Don Valley to the north-east of Sheffield. This acted as a stimulus for the RCHME to consider the urban character and heritage value of this part of the city, and they undertook a rapid survey that identified not just historic buildings, but many other structures associated with the metal trades. Over 100 sites were identified as having potential significance, culminating in a much more detailed survey, the *One Great Workshop* project. This set out to provide a detailed understanding of the diversity of metal trade sites, and their levels of survival, to enable informed decisions to be made by English Heritage and the Department for Culture Media and Sport (DCMS) in regards to their future designation and scheduling. The Butcher Wheel was identified

as one of the more significant and threatened sites (Giles 1996), ultimately resulting in reclassification in 2003 as a Grade II* listed building.

The Cultural Industries Quarter

The Cultural Industries Quarter (CIQ) was formally designated as a Conservation Area in 2001. It covers an area of 24 ha and includes nine listed buildings and many others with historic character and local significance (Fig.1). The CIQ incorporates the planned street formation laid out for the Duke of Norfolk's Estate and the Butcher Wheel is a landmark building within this area; however, in 2001 it was considered to be a 'building at risk'.

Responding to the designation of the CIQ, Sheffield City Council established a Townscape Heritage Initiative (THI) with funding from the Heritage Lottery Fund (HLF) to offer grants to regenerate both the historic environment and local economy. This funding aided the redevelopment of the Butcher Wheel, a project that was intended to act as a catalyst for the regeneration of the wider area to bring vacant historic floor space back into use.

Restoration of Butcher Wheel

Whilst the buildings were still in partial use until early 2004, the majority of the upper floor spaces were empty and had suffered from gradual neglect and disrepair. The long term viability of the Butcher Wheel was addressed in a Conservation Statement by Donald Insall Associates (2004). The site was subsequently acquired by the developers J. F. Finnegan Ltd, who worked with Race Cottam Associates to undertake the conversion and reuse, in accordance with guidelines set out in the Conservation Statement. ARCUS monitored the conversion and were able to provide additional

information during the repairs regarding the significance of areas of the historic fabric and the retention of historic artefactual material.

Chapter 2 – The Growth of the Sheffield Metal Trades

Introduction and Origins

Sheffield had developed into a sizable settlement by the 12th century, with a castle, market and a population of up to 2000 (Hey 1998, 18). It was during this period that it developed a reputation for the manufacture of cutlery, with the earliest identified cutler, Robertus le Cotelar, listed in a lay subsidy taxation record of 1297. Further references in the Poll Tax returns of 1379 (Unwin 2002, 14) document other metal workers, although London dominated the trade and from the 14th century London had the largest output of cutlery in the country (Hey 1998, 36). Unlike Sheffield, London had an established craft guild that tightly controlled the production of blades, ensuring that each item carried the mark of a dagger. In addition, London trade marks had a value and could be bought and sold, whereas in Sheffield when a cutler applied for their Freedom they registered a unique mark which they retained throughout their career (Unwin 2002, 15).

In the post-medieval period, the rental accounts for the Earls of Shrewsbury list 14 cutlers' wheels in operation in Sheffield and Ecclesfield in 1581 (Ball *et al*. 2006, XV). By the 17th century, however, Sheffield's reputation for cutlery production had grown dramatically, with three out of every five men working in some aspect of the trade (Hey 1998, 60), and output began to rival that of the capital.

[Fig 4]

Although the relative isolation of Sheffield from other urban centres makes its development as the centre of the cutlery industry appear rather illogical, it is widely accepted that its success is largely down to its geographical location and proximity to raw materials. The rivers of the Sheaf, Porter, Rivelin, Loxley and Don provided a

natural source of power to operate the grinding wheels (Fig.4). Fuel in the form of coal, charcoal and coke was abundant in the region, along with sandstone for the production of grinding wheels (Beauchamp 2002, 53). Ganister clay, for the manufacture of crucibles, and iron ore was also readily accessible.

Individual Trades and their Infrastructure

The development of a trade structure in Sheffield during the 17th and 18th centuries was unlike other factory-based industries. The manufacture of cutlery, or edge tools, required a huge network of craftspeople, each producing one stage of the finished product, be it a knife, file, tool, or handle. Their inter-relationship with one another is succinctly described in an edition of *The Penny Magazine* published in 1844:

> *All these departments of Sheffield manufacture, and others which we have not particularly noticed, are in themselves separate branches, and are only united in respect to the larger merchants and manufacturers. These manufacturers buy the steel from one or more firms, have it forged by another or several others, ground by others, and finished by others; or they will purchase ready-made goods from smaller manufacturers; or they sometimes advance money to workmen to purchase material, and then agree to give a certain price for the articles. In short, there are several modes of conducting the manufacture, but the factory system is not one of them. By this we mean, system is not one of them. By this we mean, that there is no large building, under a central authority, in which a piece of steel goes in at one door, and comes out at another converted into knives, scissors, and razors. Nearly all the articles of cutlery made at Sheffield travel about the town several times before they are finished. There are, however, a few large firms which, besides selling all the*

> *various kinds of cutlery, manufacture largely on their own premises*. (*The Penny Magazine* 1844, 4)

The ‘Sheffield metal trades’ included a huge range of products, although the regional specialism was for the manufacture of cutlery (Wray 2001, 8). It can broadly be subdivided into either flatware, or hollow-ware, although the correct meaning of ‘cutlery’ is simply an implement with a cutting edge, such as a knife, pair of scissors, a razor, sickle, or scythe. Flatware denoted forks and spoons, whilst other table ware such as dishes, trays and teapots are classed as ‘hollow-ware’ (Unwin 2002, 13).

Company of Cutlers

The quality and output of cutlery produced in Sheffield was a valuable asset to the town and the cutlers sought to protect their business by formally registering an individual’s mark, and establishing trade rules that were enforced by the manorial court (Barraclough 1989, 9). By 1568, 60 marks had been registered, and the Cutlers’ Ordinances of 1565 stipulated that a minimum of seven years as an apprentice was necessary to enter the trade. It was also stipulated that manufacturing must cease twice a year, a fortnight in August and a month at Christmas. The Ordinances also stipulated that the manufacture of goods by outsiders (i.e. not of the town) was banned, and extended to the provision that outsiders could not even be supplied with partially finished articles for completion away from Sheffield (Barraclough 1989, 9). In 1590 the rules were revised, when the closed season in August was extended to a whole month, and a second apprentice could be taken if the first had served six years. Further minor revisions were made in 1614, when entry to trade could be bought for £5.

In 1617 the Earl of Shrewsbury died without a male heir, and in the absence of a Lord of the Manor the control of the cutlery trade was no longer enforced by the manorial court. To ensure the future success of the trade, the cutlers successfully petitioned Parliament, who granted an *Act of Incorporation* in 1624. This formally established 'The Company of Cutlers of Hallamshire', who adopted many of the rules imposed by the former manorial court. Notable differences, however, included a reduction in length of the close seasons, and the requirement that all masters had to have served a seven year apprenticeship, thus removing a loophole that had previously allowed craftsmen to 'buy in' to the trade. When the charter was granted in 1624, there were 498 masters registered in the 'Great Mark Book', comprising 440 knife makers, 31 shear and sickle makers, and 284 scissor makers. Gradually, additional associated trades were admitted, including scythe makers and awl-blade smiths.

The Cutlers' company was headed by a Master Cutler who was elected for one year from among the company. Other officers included two Wardens, six Searchers and 24 Assistants. The Searchers helped monitor and control trades, being responsible for quality control, and could enter premises and search for 'deceitful' wares, such as cutlery without a steel edge. The Company controlled work in Hallamshire and 'six miles around', comprising the parishes of Norton and Eckington in Derbyshire, and was responsible for binding apprentices, admitting freemen, registering marks and administering regulations to ensure quality of workmanship (Unwin 2002, 14) .

Towards the end of the 18th century, many of the cutlers viewed the Company as too disciplinarian, and as a result the most draconian rules were disregarded (Unwin 2002, 17). This unease and resentment coincided with two new Acts of Parliament in 1791 and 1814. These Acts diminished the role of the Company, to one that simply registered the individual marks of the cutlers.

The Little Mester

The term ‘Little Mester’ is synonymous with the Sheffield cutlery trade, however it is essentially a term that originated during the 19th century following the demise of the role of the Company of Cutlers. The majority of Little Mesters were Freemen of the Company, who had the privilege to work alone, take employees, or work as sub-contractors. Freemen are the men whom the Cutlers’ Company described as owning their own work, denoting the right they held to record their freedom and mark. Those craftsmen who chose not to become registered had to work for others and were often referred to as ‘journeyman freemen’ (Unwin 2002, 19). These workers could still be a trained craftsman, but they were without an identifying mark, and therefore forbidden to take apprentices.

Allied Industries

Allied industries comprised of activities associated with the cutlery trade, many of which could be regarded as skilled crafts in their own right. One of the more prolific of these was the handle or haft maker, who worked in a diverse range of materials including, bone, horn, ivory, ox, buffalo, and mother of pearl. Cutlery manufacture, like many other trades in the 18th and 19th centuries, was supported by a wider network of tradesmen and suppliers. The roles undertaken by the hafter included the import and processing of steel into blanks of metal, the extraction and distribution of fuel such as coal and coke, the quarrying and hewing of grindstones, provision of horses, carts and their stabling, removal of waste materials and bi-products, supply and manufacture of chemicals for etching, printing of labels and manufacture of packaging boxes.

Development of Urban Workshops

The workshop (or shop) varied in size depending upon which aspect of the metal trades, or process, was being undertaken, and whether motive power was needed. Grinding was originally hand powered, although water-powered workshops were being used in the river valleys to the west and south-west of the city by the 16th century. Workshops requiring power were traditionally located on one of the five rivers flowing through Sheffield (Fig.4). By the 1780s, the rivers were at full capacity, with no new locations suitable for additional workshops (Ball *et al.* 2006, XVi). For example, the River Don had on average three water-powered sites per mile, the Loxley and Sheaf had four, and the Porter and Rivelin had five or six (Wray 2001, 10).

The introduction of steam power during the late 18th century reduced the dependency of powered workshops upon water, and for the first time allowed workshops to move closer to the central areas of the town. The first area to be developed outside the boundary of the medieval settlement was the Crofts, a dense network of streets to the north-west of West Bar and Broad Lane (Fig. 1). Here, numerous workshops were established, arranged around small courtyards (or courts) which were notorious for their cramped and unsanitary living conditions (Belford 2001). The resultant urban character was one where the workshops and dwellings were densely packed together. Beauchamp (2002, 54), however, has demonstrated that the locations of the workshops, and the housing occupied by the craftworkers and their families, were largely in the expanding suburbs of the town, with grinding still being concentrated along the river valleys. The population continued to grow as the demand for cutlery and edge tools increased, being 46,000 in 1801, 135,000 in 1851, and 409,000 in 1901.

Many of the smaller works were unpowered, containing workshops of varying sizes, providing a flexible space for a multitude of craftsmen. Many different stages of cutlery manufacture could be undertaken in such shops, and it was common to find these working communities comprised of a great variety of trades within one site. The Sheffield trade directories indicate the changing tenants and suggest that the make-up of the various workshops and works was constantly evolving. This is also commented upon by Jones and Townsend (1953, 18), who consider that whilst there were certainly large buildings for cutlery production, they were essentially 'aggregations of craftsmen's workshops', totally unlike the textile factories that developed elsewhere in Yorkshire, Derbyshire and Lancashire, which were purpose-built large structures (Giles and Goodall 1992).

Power

The introduction of steam engines to power the various processes such as grinding, buffing and stamping was revolutionary and marked the beginning of a change in the location of key manufacturing sites (see Williams 2003). Gas appears to have been largely utilised as a lighting source, which lengthened the working day, especially during the winter months. Electricity was introduced into Sheffield at the end of the 19th century with the construction by the Sheffield Corporation of a power station on Kelham Island. This was primarily for the electrification of the tram network, but electric motors to power the machines in many workshops were gradually introduced in the succeeding years.

Cutlery Manufacture

The manufacture of all forms of cutlery broadly followed the same basic stages of production. Strips of iron were converted in a cementation furnace into steel, which

often underwent further refining in a crucible furnace. The metal was then processed to improve its metallographic structure and strength, by being worked either in a rolling mill, or a power forge where it was passed under a tilt hammer (Wray 2000, 12). At this stage, the raw material would have been formed into blanks of varying sizes and quality. The first stage in the manufacture of cutlery was hand forging, following which an edge was ground onto the blade. The item would then be ready for assembly by a cutler, final polishing, packing and dispatch to the warehouse, or point of sale.

Steel making

Prior to the mid-18th century, steel was imported into the South Yorkshire region from the continent and, later, from around Newcastle-upon-Tyne (Cranstone 1997, 3). There was, however, a preference for Swedish bar (wrought) iron, the most universal raw material for steelmaking from the early 18th to mid-19th century. This material was produced from a concentrated group of forges in the Dannemora, or Oregrund areas of Sweden (Barraclough 1984, 36). The development of the English steel industry that made use of this imported raw material was initially concentrated around Newcastle (see Cranstone 1997). By the end of the 18th century the industry had, however, largely transferred down to Sheffield, establishing a technique referred to on the continent as ‘The English Method’.

This production technique involved the heating of iron bars in close contact with charcoal in an environment devoid of air. The process required a domed ‘cementation’ furnace with a conical chimney between 35 and 60 ft (10.7–18.3 m) high. Within the domed heating chamber, were two parallel chests made from either stone, or refractory firebrick. Each chest was carefully packed with 8 to 20 tons (8,128–20,321 Kg) of bar iron. That was covered with a fine powdered charcoal and

sealed with sand and wheel swarf (Wray 2000, 6). During firing the steel bars adopted a blistered surface caused by the formation of small pockets of gas during the conversion process, hence the name blister steel. This technique produced a good quality steel, although it was not suitable for items requiring a highly polished surface. The metal could, however, be improved by forging together a bundle of 9 to 12 bars under a tilt hammer to make shear steel, which had good flexibility and maintained a cutting edge. This in turn could be forged again to produce a top-quality double shear steel (Wray 2000, 5).

The superior product, however, was cast, or crucible, steel. This involved the re-melting of lumps of blister steel at a high temperature, *c.*1,600 degrees centigrade. Crucible steel was developed by a Doncaster clockmaker, Benjamin Huntsman, in *c.*1742 to fulfil his requirements for a better grade of metal to manufacture springs and pendulums for clock making (Wray 2000, 6). Huntsman was instrumental in the design of a new form of industrial building, which was characterised by the position of the chimney stack (Hawkins 1989, 4). These furnaces comprised a main ground level workshop, with good ventilation provided by large windows and roof hatches. The interior was dominated by a single, or a series of large chimney stacks that carried rows of vertical flues, held together by iron ties.

Tall clay crucibles were pre-heated and then the lumps of blister steel, and additional ingredients, were lowered into small chambers, or melting holes, set within the floor in front of each chimney stack. The crucibles rested on a bed of coke, supported by iron firebars and heated with a draft from a vaulted cellar below (Jessop 2009). Once the metal was molten, the crucibles were removed and the metal was poured (or teemed) into two piece ingot moulds, often vertically set within low pits in the

workshop floor (teeming pits). Once cool, the moulds were separated and the cast ingot was ready to be manufactured into an edge tool, or blade.

Forging

The production of cutlery, blades or edge tools started in a forge. Steel rod, or bar iron, would have been shaped into blanks by individual craftsmen who worked from small workshops adjacent to their homes, or in a tenement factory. Within many of the urban works, hand forges would be arranged adjacent to one another on the ground floor facing the yard, with flues from the hearth rising through the building terminating in external chimney stacks. Such arrangements have been noted at other Sheffield sites, including the Portland, Beehive, Trafalgar, and Brooklyn Works (Fig.1).

The hand forge was a single room with a distinct external appearance (Wray 2000, 49), comprising a split stable-type door, with an adjacent casement window, often sharing a single lintel. The size of individual workshops varied, although rural sites tended to be larger than urban ones (Beauchamp 2002, 87). The workshop in the north-east corner of the Butcher Wheel should, perhaps, be regarded as a typical example, being only 5.25 ft x 8.2 ft (1.6 m x 2.5 m) in size. The hearth was located away from the light, as the forger judged the temperature by the colour of the blade. The metal anvil (or ‘stiddy’) would be positioned below the window, and mounted within either a tree trunk, or a sandstone block.

The forger heated the steel rod in his hearth until it glowed red, using hand-operated bellows to heat the coke in the hearth. The heated rod was then hammered into shape on the stiddy, a process that included the formation of a tang for the handle. In some cases, the tang was forged from iron and welded separately to the steel blade. The

forging of larger blades required assistance from a ‘striker’ who took it in turn to beat the metal and work it to the correct thickness. After forging, the blades would still bend and blunt easily, so a secondary process was necessary to harden the metal. To address this, the blades would be carefully re-heated in the furnace and once the required temperature was reached they were quenched by being plunged into either a tank of water, or oil.

Grinding

After forging, a sharp cutting edge was added to the blade. This was undertaken by a grinder in a trough (or trow) that held a rotating grindstone. Troughs were either hewn from solid blocks of sandstone, as seen at Wisewood Forge on the River Loxley (Fig.1), or formed from riveted sheets of iron. However, by the mid-20th century concrete was used for the manufacture of grinding troughs, as in the west range of the Butcher Wheel.

The grinder leaned over the spinning grindstone, and depending upon the size of the blade being ground, a wooden stick (a ‘flatstick’) might be used to press the blade against the stone and control the process. The blade would be ground until it was bright all over and a sharp cutting edge had been formed.

[Fig 5]

At the end of each trough was an angled wooden board (splash board) to catch the wheelswarf and water spray from the rotating wheel (Fig.5). Behind the splash board, metal containers (or kits), were used to top up the water level in the trough to maintain a constant depth. The grinding wheel was clamped to an axle with a metal plate, which both strengthened the wheel and reduced uneven wear in the central hole. At one end of the axle was a wooden pulley, which held the drive belt powering the

wheel. The belt ran behind the grinder and through a wooden block (the bearstake), which maintained tension to the power drum at the rear of the workshop.

The grinder sat astride the trough on a wooden seat (horsing), which was held in place by wrought iron chains that could be raised and lowered by the removal of wooden packing as the wheel gradually wore down. A U-shaped piece of wood (the robin) was attached at the junction of the horsing and the grindstone.

Layout of a Grinding Hull

[Fig 6]

Sheffield grinding workshops were locally known as hulls, with a standard layout comprising of parallel rows of troughs (Fig.6). The workshops usually had a row of windows along one wall only, with the other walls used for securing belt drives, and for the storage of smaller wheels. Each grinding wheel was set at right angles to the line shafting, with the largest wheel, used for coarse grinding, closest to the windows. Behind this, two further wheels for smoothing and polishing would be arranged.

Continuous leather belts ran from rotating drums set at the rear of each row of grinding wheels (Fig.6). They were set in a recessed channel and connected to the pulleys attached to the axles (or spindles) of each grindstone, being manually engaged and disengaged by throwing a lever.

Once an edge had been ground, it would be polished, or glazed with an emery coated wooden wheel 2–3 ft (0.6–0.91 m) in diameter and 2 inches (50 mm) thick. Second and third polishes, would then be necessary using a leather-covered wheel dressed with flour emery, or rouge polishing powder, suet and beeswax, until the required finish was achieved. The blade would then be handed over to the cutler for hafting.

Grindstones

Towards the end of the 17th century, the Cutlers' Company began to rent out grindstone quarries to ensure that there was a regular and consistent supply of stones (or cowks), for the numerous grinding workshops in the area. The largest quarries within 15 miles (24 km) of Sheffield were at Ashurst, Beeley Moor, Brincliffe Edge, Crookesmoor, Harthill, Morley Moor, and Wickersley (Farey 1811, 435–7). Stone would be hewn from the quarry, cut at the site into grindstones of varying sizes, and then transported by cart to workshops throughout Sheffield. Prices varied depending on the specific properties of each stone, and the reputation of the quarry.

Plate 1

Each branch of the grinding trade required different sized stones, dictated by the size of blade, or tool being ground (Pl.1). The size was critical, and once worn down the stones would be sold on to another grinder who required the use of a smaller wheel. The largest wheels were 6 ft (1.8 m), and used by edge tool grinders, whilst table blade grinders preferred stones that were 4–5 ft (1.21–1.52 m) in diameter and only 9 inches (228 mm) in width. Pocket blade grinders would have bought the stones when they had worn down to 22 inches (558 mm) in diameter, and often split the stone around the circumference to form two stones each 3–4 inches (76–102 mm) wide. The smallest stones were used by the razor grinder, being only 12–14 inches (305–356 mm) in diameter, and perfectly suited for hollow grinding open razors.

Chapter 3 – The Butchers: the History of the Works

A Family Business

The business was founded by George Butcher, who in the 1790s had seven apprentices working for him, including one of his sons – James. After serving his apprenticeship and gaining his freedom, James ran a small cutlery workshop at the corner of Charles Street and Arundel Lane. He had two sons, William, born *c*.1791, and Samuel, born *c*.1797 (Tweedale *pers. comm.*), who both became his apprentices. Following the death of their father, they inherited his workshop and by 1818 had become business partners, with £200 credit in cast steel (Tweedale *pers. comm.*). Initially, they traded from a number of addresses within the Aslop Fields area (Wray 2000, 2). The core of their business, however, remained centred on a property at the corner of Eyre Lane and Brown Lane, leased by William Butcher from 1819. Perhaps reflecting the success of their enterprise, the Butchers formed a new partnership with John Brown in 1826, becoming Butcher, Brown & Butcher. This arrangement was, however, relatively short lived and dissolved in 1830 when the company was rebranded as 'W. & S. Butcher' (Fig.9).

[Fig 7]

As business developed, the Butchers bought up the adjacent plots of land around their Eyre Lane works (Fig.7). By 1836 the entire Eyre Lane frontage had been acquired (Fig.8), and the works included a 7-hole crucible furnace located towards the centre of the south range.

[Fig 8]

A valuation from 1844 details that six three-storey cottages and a stable on Arundel Street were in their ownership. By the early 1850s the adjacent steam-powered

grinding wheel of J.B. Raworth (the Arundel Forge) fell vacant and was acquired by the Butchers. During this expansion, the cast steel production was moved to the rear section of the Globe Works on Penistone Road (Fig.1), which included both crucible steel furnaces and cementation furnaces, at a rent of £140 per annum (Williams 2003, 120). The proximity of their Philadelphia Works at Neepsend (Fig.1), used for tilting and rolling, will also have influenced this move away from the centre of town. The crucible furnaces at Arundel Street were then demolished to allow the creation of the central courtyard and interconnected ranges of multi-storeyed workshops.

William Butcher served as Master Cutler in 1845, when he was living at 'Five Oaks, Glossop Road' (Fig.1), a plot now built over by the Hallamshire Hospital (White's Directory, 1845).

[Fig 9]

The prosperity of the firm declined rapidly after the American Civil War, with the USA developing its own cutlery and steel industries. Samuel died in 1869 aged 73 and William in 1870 aged 79. At their deaths they had no business partners and the various branches of their business were sold off. The American firm of Durham Duplex bought shares in the company in 1921 to use as a vehicle for manufacturing safety razors. The Wade & Butcher Corporation of Jersey City, USA continued to buy shares between 1922 and 1925.

[Plate 2]

The cutlery business at Arundel Street continued as W & S Butcher (Fig. 9), still using the Wade & Butcher mark, with Samuel's son Charles Fosbery Butcher, Sigmund Kastor of New York and Alfred Williams (Pl.2) as the major shareholders, and Edward Hibberd as manager. Additional premises seem to have been acquired at

this time, with both Kelly's Directory of 1890 and White's Directory of 1902 listing W & S Butcher at no. 44 Eyre Lane, opposite the main works (Matrix Archaeology 2006). No business is listed at 44 Eyre Lane in 1879 and it seems likely that the new premises, shown on a plan of 1889 as a large courtyard building, were built by the Butchers between 1883 and 1889 (ibid.). A painted sign on the Eyre Lane frontage of the main works announcing 'Offices Opposite' suggests that the new premises at 44 Eyre Lane may have accommodated additional office or warehousing space, albeit short-lived, with a different occupier listed at 44 Eyre Lane in directories for 1910 (*ibid.*).

Charles died in 1924. In 1950, under the Chairman, Talbot Dearden, the name of the company was changed to BD Properties (Sheffield) Limited, although it was originally incorporated in 1913, and the trade marks and cutlery business was disposed of. The Dearden family continued as shareholders until 1997.

Business Expansion and New International Markets

The rapid growth of the Sheffield cutlery and edge tool industries during the first half of the 19th century was unprecedented (Tweedale 1996, 27), especially as it relied on craftsmanship and skill, rather than mechanised processes and machinery as was the industry standard by the end of the century. The growth in output can be directly correlated with expanding markets abroad. This was initially associated with tools needed for the foundation of new plantations in the colonies of the New World (Tweedale 1996, 27), as illustrated by a trade advert for the William and Samuel Butcher enterprise in 1836 (Fig.9). Future markets in America were created by the various episodes of gold prospection, the expansion along the west coast of America and the American Civil War (1861–65). The prospectors and settlers needed a huge

range of products, which were manufactured by the Butchers, including: edge tools; skates; saws; files; hoes; trowels; and joiner's tools.

All of the principal manufacturers in Sheffield benefited from these foreign markets, including – as well as Butcher – the firms of Dixon, Greaves, J. Crookes, Mapping, Marsh, Rodgers, Turner, Sanderson and Wostenholm (Tweedale 1996, 29). The importance of the trade is demonstrated by the names they gave their factories during the mid-19th century, including the America, Atlantic, Boston, Brooklyn, Manhattan, and Washington Works.

[Fig 10]

Whilst this trade transformed the financial standing of the owners, a contemporary observation from 1830 suggests that middlemen operating abroad were able to generate a significant profit on their purchase price from Sheffield:

> *if the people of Sheffield could only receive a tenth part of what their knives sell for by retail in America, Sheffield might pave its streets with silver, and that a gross of knives and forks is sold to the Americans for less than three knives and forks can be bought at retail in a country store in America* (Cobbet 1853, 557)

The firm sent large quantities of open razors, pocket knives and bowie knives to the USA, embellished with 'American' features such as eagles. Butcher was first in the market for bowie knives but was later overtaken by George Wostenholm at the Washington Works. The firm had a New York office run by Robert Wade, who had a partnership with Butcher, shown by the many goods marked Wade and Butcher sold in America and Britain (Figs. 10–11).

[Fig 11]

Although business suffered following a dramatic decline in trade in the latter part of the 19th century, Sheffield was still regarded as the dominant force in world cutlery (Tweedale 1996, 99), with exports in 1857 of £4 million, reaching a peak in 1872 of £5 million, largely as the output of other countries such as Germany and America was deemed as being inferior. However, the introduction of massive steel works in the Don Valley turned the focus of the Sheffield metal industry away from cutlery and cast crucible steel, to the heavy steel trades championed by Firth, Jessop and Brown. During the 20th century, highly mechanised foreign competition rapidly began to dominate the cutlery trade, and Sheffield never recovered its position as the market leader.

Phased Development and Overview of Buildings

The buildings that form the Butcher Wheel represent a long period of piecemeal development on six separate plots of land acquired between 1800 and 1860. The Eyre Lane and Brown Lane frontages retain the earliest buildings (Fig.3), although they have been extensively altered and internally reconfigured. A total of 12 broad periods of alteration and development have been identified (Fig.12).

[Fig. 12]

Phase 1a: Early 19th century

The origin of the Butcher Works can be traced to the early years of the 19th century. The survey of the area in 1808 by Fairbank depicts the plot as being vacant, however leases from 1816/18 confirm that William Morley had acquired the land that later became the north-west section of the Butcher Wheel. The following year, in 1819, William Butcher leased the plot from Thomas Holy to the north of Morley fronting Eyre Lane. Development along Eyre Lane took the form of back to back houses on

the corner of Eyre Lane and Brown Lane (Fig. 3, building A). On Eyre Lane itself, a workshop was constructed on the land leased by William Morley (building M) and a warehouse/workshop (building B) in the central plot. Dividing these properties was a narrow lane (Fourteen Foot Lane) that provided direct access to Arundel Street. Towards the east end of Brown Lane a large multi-storey works (part of the Arundel Forge) was built (building G).

Phases 1b: Early 19th century

A plan of 1822 depicts a narrow range to the rear of Building B and facing Fourteen Foot Lane. This had been occupied in 1818 by Francis Castleton, although it was now under the ownership of William Butcher. There was also an addition to the north-east corner of the Arundel Forge.

Phase 1c: Early 19th century

The Eyre Lane façade was enhanced by formalisation of access into the northern parts of the site, comprising two arched cart passages with accommodation, and workshops above.

Phase 2a: 2nd quarter of the 19th century

Development in the late 1820s appears to have concentrated upon improving the workshops, warehouses and rooms along Eyre Lane where the Butchers had consolidated three separate plots into a single edge tool works. This included the addition of a second storey above buildings A and B and the insertion of a staircase within the south cart passage. The Fairbank rate book from 1836 (Fig.7) depicts the arrangement of workshops and yards operated by the Butchers, which included a 7-hole crucible furnace with ancillary edge tool workshops and stores.

Phase 2b: 2nd quarter of the 19th century

Further additions were gradually built within the courtyard, including a new range that backed on to building A and faced the access provided by the north cart passage.

Phase 3: 2nd quarter of the 19th century

Towards the middle of the 19th century the Butchers started to make efforts to consolidate their business operations, which can perhaps be seen in their alterations made to the north-east cart passage along Eyre Lane. The passageway was blocked and new rooms built above, that over-sailed the courtyard. With access now being restricted to the north-west passageway, the site was becoming more cramped and the need for space was at a premium. They continued to infill open areas, including a small square yard that opened onto Brown Lane (building F).

[Fig. 13]

Phase 4: Mid-19th century

By 1854 William and Samuel Butcher had been successful in purchasing the two plots flanking Arundel Street and Charles Lane, which consolidated their ownership along the Brown Lane frontage. It was at this time that they were investing in their steel-making capacity at their outlying works at Philadelphia on the River Don (Fig.1), which coincided with the redesign of the Butcher Wheel on Eyre Lane. This may have all resulted from their purchase of the Arundel Forge (Fig.13) on the corner of Brown Lane and Arundel Street, which comprised a series of steam powered multi-storey grinding workshops and ancillary buildings arranged around an L-shaped yard. The Arundel Forge workshops fronting Brown Lane, with their characteristic blind wall upper floor grinding shops, were improved by the addition of a new second floor, which was adapted into a packaging and preparation area.

Phase 5: 3rd quarter of the 19th century

Following their acquisition of all six plots between Eyre Lane and Arundel Street, the Butchers embarked upon a wholesale reorganisation of the works. This included the blocking of the north-west cart passage to form a caretaker's house. A narrow yard to the south of building A that fronted Brown Lane was in-filled, forming building E. The centre of the site was cleared of buildings to form a large courtyard. Along Arundel Street a new, imposing frontage range (building K) was built. This occupied a commanding position in the centre of the street and provided new workshops, packaging and warehousing rooms above to meet the demands of their successful expansion on the international market.

Phase 6: Late 19th century

Following William Butcher's death in 1870 the company continued to trade, although the American interests were sold off. A new West range was built between 1871 and 1889 and was accompanied by a new steam engine, boilers and large chimney with a suite of toilets surrounding the base (Fig.14). This new construction included the rebuilding of building M in the north-west corner of the site, although elements of an earlier structure were retained at ground level. Additional premises at no. 44 Eyre Lane, opposite the main works may also have been built by the Butchers between 1883 and 1889 (Matrix Archaeology 2006).

[Fig 14]

Phase 7: Early 20th century

The introduction of electric power in the period *c*.1910–20 involved the removal of the bank of boilers in the south-east corner of the courtyard and the construction of two single-storey generator houses (buildings P and Q). The steam engines were also

decommissioned and many of the grinding troughs were in-filled and buried beneath a concrete floor.

Phase 8: Mid–late 20th century

The management and operation of the Butcher Wheel was taken over by John Dearden, who let the various workshops to individual tenants, undertaking both cutlery and light engineering activities.

Phase 9: 21st century

Following a period of decline and only partial occupancy, the site was sold for redevelopment by J. F. Finnegan Ltd and partners. This involved the refurbishment of the ground floor workshops and conversion of the upper floors to apartments, which included the demolition of the motor houses and opening up of the former north-west cart passage on Eyre Lane.

Description of the Building Ranges

The Butcher Wheel comprises 17 individual building components, which are described in the following discussion.

[Fig. 15]

Eyre Lane/Brown Lane Buildings

On the corner of Eyre Lane and Brown Lane was a former house, building A (Figs. 3 & 15). The building was three storeys in height, with a pitched roof clad in Welsh slates. The lower storeys were constructed with a red-orange handmade brick of poor composition and irregular bond. The upper storey was built of paler machine-pressed brick and was a secondary addition.

[Fig. 16]

The Eyre Lane elevation featured a symmetrical arrangement of tall windows, centred slightly right-of-centre, with segmental brick lintels and sandstone sills (Fig.16). There was a central window at first floor level, and although there was no street doorway, breaks in the bonding pattern demarked the location of former doorways and explained the arrangement of the windows.

The Brown Lane elevation featured a brick gable with several inserted openings at ground and first floor level and a symmetrical arrangement of three large square windows in the added top storey. The door and lower window blockings were of differing dates, indicating that the internal layout had been reconfigured on numerous occasions. Internally, four brick vaulted cellars were recorded, each measuring 9.85 ft x 18 ft (3 m x 5.5 m). They featured a stone winding staircase within a narrow brick stairwell, with storage space underneath.

[Plate 3]

The ground floor plan comprised two long, narrow rooms, each with a chimney breast at the west end, although they had originally been subdivided to form four equally sized houses arranged over two storeys with a cellar below (Pl.3).

[Fig. 17]

The first floor comprised three rooms, one an office that occupied the entire north side of building A overlooking Eyre Lane (Fig.18). The walls were plastered, with deep moulded skirting, with a fireplace in the west wall. There were inserted doorways in each chimney breast alcove, although the north alcove had been blocked with shelving. The shelving was set in a round-headed opening matching the doorways on the south wall, having a roll-moulded plaster edging and a recessed timber frame with simple beading. The south wall had three openings and a large enclosed safe in the

south-east corner. This former office had been converted to a kitchen in the mid-20th century.

The south-west door to this room was a modern flush replacement, set in an earlier moulded architrave. The south-east door was a low-waisted semi-glazed type, with a moulded lower panel, and frosted glazing above with an etched Greek key motif. An adjacent room, a former office, had a single window overlooking Brown Lane. The east wall had a broad shelf feature with wainscoting below. The architrave was plain and carried a set of double folding shutters, decorated with a simple rectangular incised border, echoing the Greek key design on the frosted glass on the internal window between the two offices (Pl.4).

[Plate 4]

Traces of an elaborate Gothic-inspired wallpaper were recorded in the wall reveals of the frosted glass doorway, indicating that this suite of rooms was of high status and unlike any other in the complex. They are, accordingly, interpreted as the directors' offices (Pl.5).

[Plate 5]

The second floor was an open-plan workshop that was a secondary addition (Fig.21). A wide king-post truss of sawn timber spanned the centre of the room. The two west windows had gas fittings in the left architrave, with a workbench running across the full width of the wall. A 20th-century partition had been inserted to create a small office in the south-west corner of the room. There was direct access from the four-storey range (building D) to the south-west and a covered timber walkway from building F to the south.

Eyre Lane Warehouse and Cart Passages

The central section of buildings along Eyre Lane comprised three distinct elements of varying age: the eastern two bays represented an in-filled former cart passage and house; the central section was a former warehouse and workshop; and the western section was a second cart passage that had been converted to a caretaker's house. All of these changes were visible as structural joints within the brickwork of Eyre Lane (Fig.16). At the east end, there was a butted joint with building A at first and second storey levels. There was a keyed joint in the third storey. At the west end of the elevation, there was a straight joint with the four-storey block, building M; the adjacent brickwork of the cart passage butt-joined against this, where there was an added third-storey that continued to meet building A to the north.

There were two cellar lights, adjacent to the north-east cart passage, with the fenestration above arranged in an irregular pattern reflecting the internal re-ordering of the room layouts. The majority of windows were of double-hung sash type. Vertical straight joints indicated that there was a blocked doorway between the north-east cart passage and the bay 1 window, in which a similar window had been inserted. The cart passages were defined by dummy ashlar quoins, with shallow 'basket arches' of three segments, including a dropped keystone. Both cart passages had been blocked, with single doorways inserted. There was a painted sign, 'Offices Opposite', above the north-east arch.

The ground floor rooms between building A and the north-east cart passage had a higher floor level, presumably originally accessed via a short flight of steps from the street. Beneath was a large cellar that had a secondary sub-division with a flagstone floor. The ground floor room had a large chimney breast in the east wall and a complex arrangement of staircases in the south-west corner. This is where access was available to the upper floors, and the steps represent an amalgamation of different

builds. On the first floor was a small office, although this had once been a domestic room with a large fireplace against the east wall, similar to the arrangement on the floor below. The room could be accessed from two staircases, one in either corner of the south side of the room.

The blocking of the north-east cart passage retained pedestrian access to the street and courtyard, via the interconnected stairwell in the south-west corner of the adjacent house. However, built into the rear section facing the courtyard was a small room, with a single window facing south. This was found to retain a complete hand forge that had been created when the cart passage was blocked.

[Plate 6]

A large stone block was positioned in front of the window to house the anvil (Pl.6), and there was a hearth built against the north-east wall with an overhead hand operated bellows (Pl.7). An enclosed flue was attached to the ceiling to transfer the waste gases from the hearth, to an external vent in the courtyard.

[Plate 7]

The centre section of the range, comprised a single rectangular workshop, created by combining two smaller rooms and accessed from the courtyard to the south. The floor levels had been adjusted, although the scars of two forge hoods survived on the ceiling. The first floor room reflected the same arrangement as below, with evidence for benches along the walls and later doorways providing access to the adjacent rooms.

[Plate 8]

Prior to the conversion of the north-west cart passage to a house, a substantial stone staircase, with a double flight on the upper floors, was built against the west wall

(Pl.8). This was accessed from the courtyard and gave access to the upper floors of building M. The creation of the caretaker's house involved the construction of a series of partitioning walls to form two rooms on the ground and first floors and a single bedroom on the second floor. A later insertion was a bath, which had been positioned on the first floor landing.

[Fig. 18]

The upper floor of building B over-sailed the three separate lower structures and was a later addition (Fig.21). Access was originally from the stairway from the north-west cart passage. The internal re-ordering of the rooms and floor levels resulted in the upper floor of building B being accessed from the third floor of building A, although externally, the windows were on the second floor. Originally, this floor was divided into two long workshops, with benches in front of the windows. Later partitions, however, created a series of smaller rooms, with shelving, a walk-in cupboard and an enquiry hatch opening onto building D (Pl.9).

[Plate 9]

Building M: Eyre Lane West range

Forming the north-west corner of the site and fronting onto Eyre Lane was a four-storey high structure of hard machine-pressed red brick (building M), with external measurements of 37.7 ft x 28.2 ft (11.5 m x 8.6 m). Externally it appears to be contemporary with the construction of the West range (building L). It had a double-pitched roof clad in Welsh slates, with a hip at the west end. A stairway from Eyre Lane led up to the west of the first floor, although principal access to each level was from the stairwell built within the north-west cart passage.

The Eyre Lane elevation (Fig.16) comprised four bays of windows at upper floor levels, with an additional narrow bay at the east end of the fourth storey that was built over the elevation of building B. In contrast, the ground floor elevation had four round-headed arched windows with projecting stone lintels, between two inserted doorways.

The courtyard elevation comprised a narrow single bay that projected forward from the façade of the West range. There was a ground level doorway from the courtyard, with narrow round-headed windows above. These were originally designed as taking-in doors for grinding wheels, with an offset fabricated bracket at second floor level, carrying a pulley wheel aligned with the corresponding bracket on the north elevation of building L.

The floor plan originally comprised a single room on each floor, with an external linking stairwell to the courtyard on the east side. Doorways in the south wall provided a direct link to the workshops in the West range. The ceilings of the lower two floors comprised brick jack arches supported from a central row of cast-iron columns, similar to building L. Belting slots integral to the arches allowed vertical power transmission from a former steam engine located on the ground floor, the only surviving evidence of which was a massive sandstone block built into the south wall that may have formed part of the mounting for a flywheel. The brickwork of the ground floor was notably cruder than that of the external elevations and upper floors, and represents a surviving element of the former early 19th-century workshop built in this corner of the site.

The open plan upper floors were well lit from the north elevation, with high ceilings (Fig.17). Each functioned as grinding workshops, with remnants of inserted concrete troughs with mounting blocks for electric motors and line shafting brackets around the

walls. Interestingly, the third floor was unlike the lower levels with sunken brick-edged troughs built within the floor, of an identical design to those in the West range. Four banks of troughs were recorded, although those along the south wall had been replaced with a raised concrete floor mount from a removed piece of machinery. There was no ceiling, the rafters and slate battens being exposed to the ridgeline, with three sawn king-post trusses. The north-east door was modern, although set within an original beaded frame with a stone threshold. The original door had been hung from pintles, which were still *in situ*.

Building C: Three storey range

This was a rectangular structure projecting into the courtyard behind building B, with a pitched roof clad in Welsh slates and a footprint measuring 33.1 ft x 16.4 ft (10.1 m x 5 m), orientated north-south (Fig.15). It was constructed with orange-red handmade bricks and originally backed on to the former Fourteen Foot Lane that once bisected the site. The principal elevation faced east, and had a notable mis-match between the fenestration of the lower two storeys and the upper ones. The ground floor had been altered by the insertion of later doorways, however, the original arrangement of four bays of three-light windows survived intact at first floor level. In contrast, the second and third storeys displayed a generally uniform arrangement of five equally-spaced bays of double-hung sash windows. There are late 20th-century raking brick buttresses built against the ground floor. The roof had a shallow pitch clad in Welsh slates, with a gable forming the south wall (Pl.10).

[Plate 10]

Between the first floor door and window was a pair of sculpted ashlar corbels beneath an elongated blocked opening, with a mortar cement scar extending to eaves level and incorporating several iron rods, representing the remnant of an external flue.

The ground consisted of two equally-sized workshops, which were connected via a doorway in the dividing wall. In the north-east corner of each room were traces of former hearths with hood details and workbenches along the south and west walls.

Built between the north wall and building B was an enclosed stairwell, leading to the first floor. This gave access to a double-sized room, although a projecting stub wall indicated that it may have once been divided as on the floor below. It had a flagstone floor built over a layer of lime-ash, representing a possible attempt at fireproofing. There was a forge hearth in the north-east corner, which had been bricked-up and the hood removed, and an additional flue by the west wall. Scars indicated that a second forge hearth had been removed from immediately south of the mid-partition wall. An open wooden stair at the south end of the workshop provided access to the second floor.

A secondary doorway had been inserted in the north wall linking with the third floor of building B. Part of the second floor appears to have been rebuilt when the over-sailing range was built above the north cart passage. A large fireplace was built into the north wall, the size of which suggests an industrial function.

Over-sailing structure in north-east yard

Built at second floor level against the rear (south) elevation of building B was a long room that over-sailed the courtyard. This measured 8.5 ft x 25.6 ft (2.6 m x 7.8 m) and was accessed via a doorway in building D to the east. The structure was carried on a large timber beam, spanning between building D and a substantial brick pier abutting building C. There were two exposed half-king-post trusses of sawn timber with a raking strut, with a mono-pitch roof. It had a single window overlooking the courtyard and had been converted to a toilet in the 20th century.

Building D

Built against the west elevation of buildings A, E and F was a long narrow range orientated north-south (building D). This was four storeys in height and measured 14.1 ft x 45.9 ft (4.3 m x 14 m), built in hand-made brick with a pitched roof clad in Welsh Slates. The east wall originally overlooked an open yard onto Brown Lane prior to the construction of buildings E and F.

At ground level there was a series of small rooms and a pair of open fronted garages facing the north-east courtyard. These rooms had subsequently been reconfigured, but they may have been originally intended for general storage and use as a cart shed.

[Plate 11]

The first floor comprised a long workshop with four windows equally spaced overlooking the courtyard (Pl.11). A partition in the north-east corner provided access to a stairwell to the upper floors and created a small storeroom, with inserted doorways into the adjacent rooms. In the north wall of this storeroom was a small enquiry hatch and associated shelving. It had a concrete floor that covered flagstones and a square chimney breast against the south gable. At the foot of the stairway was a cast-iron column, above which the ceiling extended as a vertical shaft up to the underside of the roof, possibly demarking the location of a former glazed skylight or louver.

The second floor was subdivided into two spaces by two adjacent staircases, leading to the upper and lower floors. There were windows along the west wall and a doorway into the over-sailing room built against building B. Additional access had been inserted into adjacent rooms built against the east wall. There was a large fireplace at the south end of the room and extensive benches with storage underneath. A short

corridor to the south of the north-east staircase led to a small room that oversailed the former yard of building E to the east. This room was contemporary with the over-sailing room built against building B, and was designed to house a private toilet. The room had a pitched roof and a narrow light in the east wall. There was a small Belfast sink beneath the window, with panelling formed from vertical planks painted a mid-green colour. The toilet was housed in a dark mahogany stained wooden box seat and the mechanism was an early example of a Bramah pan-flush water closet (Pl.12).

[Plate 12]

The third floor comprised a single long room, with a partitioned lobby in the north-east corner giving access to the stairwell rooms on the third floor of buildings B and A. There was a chimney breast at the south end, similar to the floor below, although there was no break in the skirting board, demonstrating that there had never been a fireplace on this floor. There was, however, an inserted flue opening in the external chimney breast on the east wall, presumably for a free standing stove. Following the construction of building F, a window in the east wall was blocked, and a connecting doorway inserted. In the south-east corner of the room a narrow angled passage had been inserted that over-sailed the courtyard; this was added when a third floor was added to building G.

Building E: Inserted loading bay

This structure occupied a narrow space between buildings A and F, fronting on to Brown Lane. The frontage was of two storeys, behind which was a mono-pitch roof clad in Welsh slates sloped down to the west. There was a raised, double leaf planked loading door with a cast iron fanlight above. Vertical joints in the brickwork

demonstrated that it had been an inserted structure against the pre-existing buildings A and F.

The ground floor comprised a raised loading floor that could transport goods via a small goods-hoist to the packing rooms on the upper floors of buildings D and F. The south ground floor wall of building A had been removed and replaced with a metal RSJ (Rolled Steel Joist) and cast-iron column. This created a double-width room that would have functioned as a dispatch and delivery bay.

The third floor level formed a large open lightwell, concealed by a brick façade facing Brown Lane. Crossing this space between buildings A and F was a flying timber walkway with a slate-hung elevation and a mono-pitch roof.

Building F: Brown Lane north range

The Brown Lane elevation was originally broken up by a rectangular yard formed between the end walls of buildings A and G. However, the construction of two walls along the north and east sides of this yard created a rectangular structure (building F) four storeys in height, built with dark red machine-pressed bricks and measuring 27.9 ft x 22 ft (8.5 m x 6.75 m). The elevation fronting Brown Lane comprised three bays of windows with a ground floor double door at the north end. The elevation appeared to incorporate at ground floor an earlier brick wall, presumably once forming the boundary to the former yard. There was a gable chimney stack and a pitched roof clad in Welsh slates.

The north elevation displayed an original arrangement of three window bays at second and third floor level, but only two at first floor level. At ground level, the elevation was blank, apart from a low, wide blocked doorway under a timber lintel at the west

end, which would originally have opened into the narrow space bounded on the north by building A and on the west by building D.

The internal floor plan comprised a single workshop on each floor, with access from adjacent structures and only limited internal access within the structure itself. Floor sockets marked the location of former benches on the east and west walls. The first floor had stone flagstones, similar to the adjacent room in building D to the west, whilst the second floor had a concrete surface poured directly over timber floorboards. The third floor had access to a connecting walkway leading to building A, and was fitted out with wall cupboards. A small goods hoist linked the second and third floors with the ground level loading bay in building E. The hoist was operated by a cast-iron chain pulley, which was inscribed with 'Weston's Patent' and 'Tangye Brothers, sole makers, Birmingham'.

Building G: Brown Lane mid-range

The Brown Lane range was a large rectangular four-storey building, which measured 26.25 ft x 62.33 ft (8 m x 19 m). The lower two storeys were part of the former Arundel Forge incorporated into the Butcher Wheel in the second half of the 19th century. The third storey was a later addition, creating a well-fenestrated workshop with regularly-spaced windows. The fourth storey was another addition in lighter machine-pressed brick, incorporating taller, double-hung sash windows.

[Plate 13]

The Brown Lane frontage was originally blind at the lower two levels with only high-level vents, characteristic of Sheffield grinding workshops (Pl.13), although later windows and a doorway have been inserted. On the upper floor the windows were of differing arrangements, reflecting the two phases of upward expansion.

[Plate 14]

Facing the courtyard, the ground floor fenestration had been much-altered by the insertion of doorways and the open-fronted bay incorporating a mid-20th-century returning stairwell at the south end of the structure (Pl.14). The west elevation was partially obscured by the later construction of a motor house (building Q). A former taking-in door was situated between the two first floor windows overlooking the courtyard. Its sandstone threshold and two truncated timbers for an external platform survived. The brickwork of the added fourth storey incorporated two external chimney stacks, which had formerly projected above the eaves of the three-storey structure.

[Fig. 19]

The ground floor formerly comprised a single large workshop space consisting of six bays of brick jack-arches, supported on cast iron columns and beams (Fig.19). In the mid-20th century a returning stairwell had been inserted in the south bay, removing the jack arches, and a studwork partition was inserted dividing the remainder of the space. The floor was of concrete. At ground level there was a brick arched recess at the north end of the east wall, indicating the position of a removed wall-box for a continuous lineshaft, along with prominent belt-scarring along the east wall.

The surviving ceiling of the main workshop comprised five bays of brick jack-arches, supported on plain cast-iron columns, tapering to a plain capital with flat top and no bolting head. Each arch had four square wrought-iron tie bars. The latter were truncated in the north-west corner, where a wooden stair flight had once been inserted (now removed). Each bay incorporated a pair of drain holes and there was a pair of iron rings located towards the west end of each bay. There was a low blocked

fireplace in the east wall, with an opposing fireplace in the west wall, although this had been removed during the addition of building Q.

The first floor comprised a single, self-contained large workshop that incorporated partitioned areas forming a kitchen and toilet. The floor was concrete and of two phases. In the north-west corner was a raised area of planked flooring concealing the former stairwell void from the floor below. There had been extensive rebuilding in modern brick between the two windows at the south-west corner, replacing the former taking-in door.

[Fig. 20]

The second floor comprised a single large workshop space, with a modern partitioning of the north bay and an inserted stairwell at the south end (Fig.20). Two chimney breasts on the west wall had low bricked-in fireplaces. There were continuous timber lintels above both window runs. A scar on the east wall indicated the position of an earlier partition at the point where the window type changed and the flooring changed from concrete to planking. There were two blocked doorways in the north wall and a floor level wall-box in the north-west corner.

[Plate 15]

The third floor was subdivided by a longitudinal partition into three rooms (Pl.15) with studwork clad in beaded tongue-and-groove, and chimney breasts on the north and west walls. The south-west door was panelled with a large lockbox. The east partition was occupied by an enquiry desk and glazed hatch, with a sliding wooden shutter. There were fitted cupboards beneath the desk, which continued through the rooms, along with extensive shelving up to the ceiling level. Within the north-west

corner of the floor a narrow passage over-sailed the courtyard below and provided a link to building D.

Building H: Brown Lane south range

Building H represents the remnant of a structure consisting of a narrow bay containing a returning stairwell and lobbies. It was visible on Brown Lane between the north elevation of the Arundel Street range, denoted by a vertical joint with building G to the north, extending up to the second floor window sill level. Above this there was no clear joint and the brickwork incorporated a concrete slab occupying three courses of brickwork spanning the joint location. The building measured only 26.25 ft x 8.2 ft (8 m x 2.5 m), representing a single bay division. The roof was pitched and slated as a single phase extending north from Arundel Street. The courtyard elevation showed no distinct joint between buildings G and H, and it was evident that the south elevation of building G had been rebuilt to incorporate that of building H.

At ground floor level the Arundel Street range (building K), was recessed to clear an arched brick opening in the elevation of building H, above which was a massive timber beam carrying the upper part of the elevation of the Arundel Street range. The overlying exposed elevation of building H was very narrow, containing three thin windows, with single windows on the upper floors. The first floor window was formerly a taking-in door for the movement of grinding stones between floors.

This remnant of building H comprised a bay incorporating a returning stone stairwell with half-landings, partitioned from small lobby spaces to the north. The remainder of the interior to the south had been demolished and replaced by the Arundel Street range (building K). At ground level, there were two rooms separated by a central

dividing wall, each approximately equal in size. The west room, accessed from the courtyard, was an open-fronted lobby with a stairwell to the rear. A cast-iron girder for a jack-arch exposed within the north wall of the stairwell section had remnants of vault brickwork adhering, and was clearly a remnant of a vaulted room that pre-dated the stone staircase. There were no windows, but several blocked openings, including former doorways in the north and south walls. Within the stairwell was a large blocked opening on the west wall under a timber lintel. Its north reveal was heavily chamfered and again was cut by the stairwell; it was presumably associated with the earlier phase, which had the jack-arch roof.

The second room to the east was accessed via an inserted door in building G, although there was also a blocked doorway leading to the former engine room at the east end of the Arundel Street range. A longitudinal brick supporting-wall extended north from the transverse wall, where there was a filled-in floor trough.

There were numerous holes and blockings in the walls. The northern section of the south wall was a blocked opening, containing a low timber wall. A brick arch above the trough by the north wall presumably once housed a wall-box for transferring power from the engine room between buildings K and G.

The first and second floors comprised a series of connecting landings and former stairwells with lobby access between buildings G and K. There were also disused sections of a stone flight stairwell on the first and second floors that had been blocked off by 20th-century alterations and the creation of the third floor. The third floor was directly connected with the Arundel Street range, although it contained a lobby and toilet accessed from building G.

[Plate 16]

Arundel Street Range

The Arundel Street range was built in a single phase and formed the whole street frontage of the Butcher Works, with external dimensions of 160.75 ft x 29.5 ft (49 m x 9 m). Four storeys in height (Pl.16), it comprised 12 structural bays, demarked by the roof trusses. The building was constructed in pale pink-red brick, with architectural detailing picked out with blocks of pale yellow sandstone comprising a substantial plinth, which was stepped-up at the east end to demarcate the former engine-house at the corner of Brown Lane; a string course at the springing point of the ground floor window arches; and sill bands at the upper storey windows, which returned to continue along Brown Lane. The roof was pitched with a hip at the corner with Brown Lane and covered with Welsh slates, with skylights spaced out along the length of the ridge and raised louvered vents along the ridge.

The fenestration was grouped, with varying widths of separation between the windows that corresponded with the internal layout of the building. The ground floor had no more than 12 windows, whilst the upper two floors were characterised by up to 29 individual openings. Two-thirds of the way along the Arundel Street elevation was a prominent cart entrance (Fig.15), aligned with the former Fourteen Foot Lane that bisected the site at the start of the 19th century, with a rusticated ashlar entrance with a flat arch and dropped keystone below a moulded cornice. Interestingly, the lower reveals had been chiselled away to create a wider opening for modern vehicles. There were double planked doors and, to the right of the entrance, a pedestrian door and a small window, both set in round-headed segmental brick arches matching the windows (Pl.17).

[Plate 17]

The Brown Lane elevation of four storeys incorporated elements of the earlier structure of building H at ground and first floor levels. At ground level there was a large iron frame associated with the internal power transmission from the former engine room at this end of the range. A staggered joint close to the corner demarked the end of the decorative facing bricks of the Arundel Street façade, with the brick coursing continuing as standard bricks.

[Plate 18]

An unusual feature of the courtyard elevation was the use of a series of inverted brick arches beneath the ground floor windows, which was an attempt to spread the loading of the flooring above (Pl.18). There was a fabricated riveted metal bracket containing a pulley wheel above a former taking-in door, now a window and angled towards a corresponding fitting on the West range.

The range originally comprised a series of subdivided workshops with brick jack-arched ceilings supported on RSJs and cylindrical cast-iron columns at ground floor. These rooms would have been used for grinding and hand forges. An engine room with a high ceiling boarded with narrow tongue-and groove planking, originally with dark varnish finish, was exposed along with remnants of a plaster cornice. In the south-east corner of the ceiling was a trapdoor, above a prominent grease stain on the wall over the brickwork blocking of the large iron frame interpreted as the location of the vertical power transmission, either belt or line-shaft to the upper floors (Pl.19).

[Plate 19]

Adjacent to the cart passage was a pedestrian entrance on Arundel Street that would have led to an office, probably functioning as a time-house with a porter. A second door set back at the top of three steps allowed access to the rear of the cart passage,

thus restricting access into the site; the door itself was a low-waisted design, with a single frosted upper pane above three narrow vertical panels with raised mouldings.

The west end of the range comprised two large workshops, measuring 21.3 ft x 24.3 ft (6.5 m x 7.4 m). The ceiling comprised two brick jack-arches, carried on a cast-iron beam supported by a single cast-iron column with simple moulded head without bolting holes. Each jack-arch had four square-section wrought-iron tie rods. There were irregularly-spaced round openings *c.*15 cm in diameter for drainage from the upper floors and two large iron lifting rings. There were two timber-framed belting slots at the south end of the west arch, above the location of a removed lineshaft drive, and a blocked fireplace in the north wall between the windows. The upper floors contained central pairs of metal RSJs forming stanchions supporting horizontal girders, possibly associated with strengthening work undertaken during the Second World War.

The first floor was subdivided in to four rooms of differing size. The westernmost room had a fireplace in the north wall, while the eastern room had the most fenestration, making maximum use of the corner with Brown Lane, with two walls containing windows. There was evidence for high wall boxes denoting line-shafting along the room and benches along the windows. Presumably power could be transferred along the full length of the floor for a variety of processes.

The central large room incorporated an inserted lift and a former stairwell bay at the south-west corner adjacent to the cart passage below demarked by opposing stub piers. There was a blocked taking-in door above the cart-passage, and the inserted window frame incorporated a grab handle and the hinges of the former door. Exposed trimmer beams in the ceiling delineated former ceiling hatches, boarded above, two in

the north-west corner of the north room and a symmetrical arrangement of three located centrally between the longitudinal joists of the central room.

The second floor latterly comprised a single long space, incorporating a small partitioned office in the north-east corner. There were two blocked fireplaces in the south part of the west wall and a chimney breast and hearth slab on the projecting north wall at the north-east end of the room.. Continuous timber members denoting former bench positions extended along the full length of both north and south walls, except above the cart passage. A taking-in door in the east wall above the cart passage was a late 20th-century insertion. There were cast iron lineshaft brackets on the west wall, although there was no other local evidence for mechanical power transmission.

[Plate 20]

[Fig. 21]

The third floor comprised a single long open workshop space, narrowing at the east (Pl.20; Fig.21). Truncated transverse wall stubs, blocked fireplaces and extensive fenestration echoed the original layout of the floor below. The exposed roof structure was open to the underside of the rafters, which comprised ten sawn-timber king-post trusses of two styles, with a hip-truss set into the chimney breast wall at the north-west corner. The trusses displayed a series of incised Roman numerals, arranged in two series, the original trusses being numbered from the west.

[Plate 21]

West Range

The West range (building L) formed the west boundary to the site, orientated north-south and four-storeys in height (Pl.21), built against the Arundel Street range (building K) to the south and the Eyre Lane range (building M), to the north. It has a

rectangular footprint, with an angled section in the south-east corner when it was built against the pre-existing fenestration of the Arundel Street range. The building was constructed using a hard red brick in a single phase, externally measuring 95.15 ft x 28 ft (29 m x 8.55 m), with a pitched roof clad in Welsh slates, with hips at either end. The west wall that backs against the adjacent Sterling Works was blind, apart from on the third floor, where there was extensive fenestration. Chimney stacks projected above the eaves on the east elevation, above end gables, and above the ridge on either side of the central stairwell.

The courtyard elevation had been much altered, by the insertion of wider doorways, the addition of building P near the centre, and by the blocking of taking-in doors on the upper levels. The ground floor layout originally comprised a mirrored arrangement either side of a central small arched stairwell doorway (Fig.15). This had comprised of pairs of large window openings serving a total of four workshops, with smaller doorway arches set in pairs. Latterly all but the central and two easterly doorways had been removed.

At first and second floor levels, there were originally taking-in doors leading off the central stairwell. The windows were aligned above the ground floor openings, with only the outermost of the four workshops having taking-in doors, located above the ground floor doorways. An additional doorway had been inserted at the south-east end, accessed by a wooden walkway and stair flight from the courtyard. Positioned to the north of the second floor taking-in doorway was a fabricated plate-girder double bracket, supporting two angled pulley wheels. These were aligned with corresponding fixtures on the courtyard elevations of building M.

The second floor windows were grouped in pairs above the first floor windows, which were spaced further apart. The third floor windows, however, were much smaller,

being arranged beyond and between the chimney flues. The west elevation was only exposed at third floor level, comprising a regular fenestration of round-arched openings containing modern blockings.

[Fig. 22]

The internal arrangements were based on pairs of workshops, flanking a central stairwell that served all floors from the courtyard (Fig.22). There was a blocked doorway to the neighbouring Sterling Works at ground floor behind the stairwell. The ground floor workshops were similar to those at the west end of the Arundel Street range, with high ceilings formed of two bays of brick jack-arches, carried on cast-iron beams supported by cast-iron columns. There were pairs of iron rings set in the ceiling vaults, with drainage holes and four sets of square tie bars. Although subsequently altered, the ground floor workshops were designed as hand forges, with a round-headed doorway and adjacent window facing the courtyard, separated by a flue for a hearth. Many of the rooms contained wall-boxes, indicating the use of power operated machinery.

[Plate 22]

The central stairwell had stone treads leading to stone landings set at half height between each floor. The stairwell continued to the third floor, although it opened out to the roof structure with a metal balustrade and simple curled handrail. The east side of the stairwell continued as landings that gave access to workshops on either floor. At both the first and second floors were taking-in doors that opened on to the courtyard, with corresponding internal trap doors on each landing and a large hand operated winch on the second floor that partially blocked the stairwell (Pl.22). These enabled the movement of heavy grindstones in and out of the workshops. The third

floor landing, unlike the others, contained a hand forge, presumably a later addition and for use by multiple workshops.

[Fig. 23]

The layout of the first floor corresponded with that of the ground floor, with pairs of workshops flanking the central stairs, with double-bay brick jack-arch ceilings supported on cast-iron columns (Fig.23). These rooms contained individual grinding workshops, with sloping troughs set within the thick jack-arch floor and powered from a rotating power drive along the west wall. Many of the troughs, however, had been in-filled, thus adapting the rooms for alternative purposes.

[Plate 23]

The second floor was similar to the first in that it was used for grinding. The main difference was that there were only two large workshops, one on either side of the central stairwell. Power was transferred from the ground floor via belt-driven drive shafts and rotating drums along the rear (west) wall (Pls.23–24; Figs.24–26).

[Figs 24 and 24b]

The south workshop still retained the arrangement of grinding troughs and their wooden superstructure, whilst the north workshop had a poured concrete floor, with integral concrete grinding troughs and mounting blocks for electric motors.

[Fig. 25]

[Fig. 26]

[Plate 24]

The third floor was supported by a timber structure, requiring less loading than the lower grinding workshops. It had been significantly altered, although originally

comprised a series of small rooms, separated by planked wooden partitions and a central corridor. There were four original fireplaces in pairs of chimney breasts on the north and south walls of the central stairway and projecting piers that carried flues from the lower floors, although the original fireplaces had been replaced. Flanking each inserted hearth was a short brick partition, acting as a fire-break.

[Plate 25]

There were remnants of workbenches running along the east wall (Pl.25), although most had been removed. The benches appeared to be of considerable age with well-worn hollows and locations for fixing bench vices. Evidence for line shafting at various locations on this floor indicates that powered machinery and process were in operation.

Courtyard Buildings and Structures

The redevelopment of the Butcher Wheel involved the excavation and re-laying of the courtyard. The courtyard gradually grew in size as the works expanded, reaching its current size by the 1890s. It was dominated by a central chimney that was linked to the engine house at the east end of the Arundel Street range via an underground flue. A bank of three Lancashire boilers in the south-east corner of the courtyard were supported upon dwarf walls built with refractory brick; these were removed following the introduction of electric power in the 1910s.

The remainder of the courtyard was surfaced with sandstone setts, typical of Sheffield during the 19th century. However, only sections of the setts survived along the western half of the courtyard, the various phases of demolition and re-ordering of the space having resulted in a patchwork of tarmac and concrete. A series of semi-circular walls recorded along the eastern (courtyard) façade of the West range and depicted on

the Ordnance Survey map of 1890 are interpreted as collecting tanks for the wheel-swarf and waste material from the grinding troughs on the upper floors. These would be periodically emptied and the contents sold for use in the production of blister steel.

To the south of the north-west cart passage (building B) and alongside building C, the remains of a brick vault were revealed during the ground works. The relationship of this cellar to the adjacent buildings and their processes was not clear, although it lay under one of the wall-bracket hoists (on building M), and may have been associated with either a weighbridge or engine of some form. Partially built underneath the north wall of the Arundel Street Range was a well. This appears to have formed part of the earlier Arundel Forge, as the foundations of the Arundel Street range were built to accommodate it. It presumably provided water for the boilers used to power the steam engine.

[Plate 26]

Building N: the chimney and privies

Centrally located within the courtyard was a brick chimney that serviced the Lancashire boilers in the south-east corner of the courtyard. This had a simple tapered profile, the top of which had been slightly reduced in height by pushing the bricks down into the flue. Inside the chimney was an internal ladder, comprising U-shaped metal rungs built into the brick. Access would have been from a hatch at the base, although this had been blocked (Pl.27).

[Plate 27]

Surrounding the chimney was a suite of nine toilets, arranged in two tiers. These were contemporary with the construction of the chimney towards the end of the 19th

century and represent the introduction of improved sanitation for the workers within the factory.

Building J: Single storey courtyard range

This was a small single-storey brick structure of two rooms, abutting the south gable of building D. The structure was built of red brick and significantly altered by the blocking and insertion of new doorways. Its function is unknown.

Buildings P & Q: motor houses

On either side of the courtyard, built against buildings G and L were two single-storey brick motor houses (buildings P and Q) constructed between 1910–1920, coinciding with the decommissioning of the steam engines and the transition to electric motors. Built of early 20th-century hard machine-pressed brick laid in English garden wall bond with single pitched slate roofs, their external dimensions were *c*. 18 ft x 19.7 ft (5.5 m x 6 m). The side elevations had windows, with double doors opening out into the courtyard. Internally, the motor houses were connected to the ground floor of each range following the removal of a section of walling and the insertion of lintels, inscribed ‘Cargo Fleet. England’.

Chapter 4 – The Butcher Wheel: analysis and interpretation

Architecture and the Ordering of Space

The first section of this chapter discusses the evolution of the layout of the Butcher Wheel and considers the influence of new legislation that was introduced in the mid-19th century in Sheffield to control unsafe and unregulated urban development. The need to protect the buildings from the spread of fire is examined, along with provision that was made for addressing the welfare of workers and improving sanitation. Following from this, technological aspects of production are considered, including the hand forges, grinding workshops and power systems.

Layout

Unlike the purpose-built public grinding wheels, such as Soho Wheel on Corporation Street (c.1820) and the Union Wheel on Alma Street (c.1817), the Butcher Wheel represents the culmination of many years of development, expansion and change. This evolution is demonstrated by the warren-like internal layout of the site, with multiple levels and a variety of forms of workshop arranged on different floors. The resultant courtyard layout at the end of the 19th century was a self-contained works separated from the surrounding streets. Such a design offered a high degree of security (Williams 2003, 122), with access to each workshop being from the courtyard and with a single cart passage entrance on Arundel Street. By the latter part of the 19th century the works had a caretaker living on the premises, as was the case at the neighboring Sterling Works (Archaeological Services WYAS 2005), who would have also had a dual role of night watchman.

Upon casual inspection, the form of the site at the end of the 20th century was one that gave the impression of an integrated factory, but in reality, this connectivity was not consciously planned. The Butcher Wheel was not designed as a cohesive series of workshops housing sequential processes, but rather its eventual form (Pl.33) involved the adaptation of the internal spaces, with connecting doorways and passages gradually inserted over the decades of its use. The final evolved layout did, however, adhere to many of the standard patterns of large courtyard manufactories that specialised in edge tools and cutlery within Sheffield, which are explored below.

Cutlery works were designed to facilitate a smooth work-flow between the various processes that were undertaken to produce a finished product. In fact, many of the workshops, offices, warehouses and rooms with multiple work benches in front of the windows could have been readily adapted to alternative industrial uses; the characteristic inclusion within these large urban cutlery works was the positioning of hand forges on the ground floors and grinding workshops above. The analysis of the interior rooms has proved difficult in some cases, but the majority can be associated with at least one specific activity (see Figs15, 18, 20, 21).

What is unusual, however, is that although a suite of offices had been adapted from former houses in the north-east corner of the site, they were never replaced with more up-to-date rooms when the Arundel Street range was built. It seems probable in this case that, at least for a short period, the Butchers maintained offices on the opposite side of Eyre Lane: a painted sign above a blocked cart passage on the Eyre Lane frontage directed visitors to ‘Offices Opposite’, and trade directories list W & S Butcher as occupiers of premises at no. 44 Eyre Lane in 1890 and 1902 (Matrix Archaeology 2006).

Similarly, it has not been possible to identify any designated space suitably furnished and heated for use as a showroom. Contemporary medium-large cutlery sites in Sheffield nearly all had such a dedicated showroom space, often in the principal frontage range overlooking the street, for potential customers or suppliers to view the latest range of merchandise, and to facilitate new orders and business opportunities. There is, of course, the possibility that there were showrooms on the opposite side of Eyre Lane (although the large courtyard building here may have been unsuited to this function), or indeed at a separate address elsewhere in the town, although this would be unusual. Many of the large manufactories in Sheffield did, however, have a postal address in London for correspondence, along with agents' offices abroad, including the Butchers, who in the mid-19th century had an office managed by Robert Wade in New York for their overseas trade.

Whilst the offices at the Butcher Wheel within building A at the corner of Brown Lane and Eyre Street were not purpose built or approached via an imposing staircase as was common elsewhere, there was a concerted attempt to make them different from the surrounding workshops, assembly, packing and storage areas. These rooms are dated to the second quarter of the 19th century and were decorated in the latest styles of gothic-inspired architectural wallpaper (Pl.5), separated from one another by frosted glass panels (Pl.4) incorporating a contemporary Greek-key motif, a design that was even picked up on window shutters and other joinery details. This modification of existing space rather than investment in new offices may be a result of the piecemeal expansion of the works, but it would have coincided with the death of Samuel Butcher in 1869 and William in 1870, at which point new offices may have been regarded as an unnecessary expense.

As has already been stated, the layout of the Butcher Wheel adhered to many of the typical arrangements of workshops and processes associated with cutlery manufacture, including the siting of the hand forges facing the courtyard, with grinding workshops positioned on the upper floors (Wray 2000, 50). Contemporary examples of Sheffield workshops with similar arrangements include the Beehive Works on Milton Street (Wray 1998a); the Britannia Works on Love Street (Giles 1999a); the Portland Works on Randall Street (Giles 1999b); and the Stag Works on John Street (Wray 2000, 45–53). The increasing amounts of fenestration on the second and third floors of the Butcher Wheel, especially along the Arundel Street and West ranges is indicative of work areas utilised by cutlers assembling the blades into finished products. Such a function is confirmed by evidence for continuous benches in front of these windows, where natural light would have been a necessity for this skilled and precise work.

One of the noticeable characteristics of cutlery works, which has been discussed by Wray (2004, 143), is that the noisy and dirty processes were often undertaken towards the rear of the works, away from the unpowered ranges on the frontage. This pattern does not seem to apply to the Butcher Wheel, however, and it should be remembered that each site is unique and subject to an individual series of factors that combine to create the final layout. This apparent individuality may, however, simply be a result of the longevity of the site and its piecemeal development.

Architectural design, bye-laws and fire prevention

The construction of the Arundel Street range followed the expansion of the site towards the south and marks a change in layout, with access being diverted from Eyre Lane to the north to Arundel Street. Arundel Street is perhaps the principal

thoroughfare in this industrial suburb, and the desire to have a postal address and entrance here must have been a motivating factor in this re-orientation. The new façade of the purpose built range was high and imposing, and whilst the use of banded decoration, with ashlar string courses, rubbed brick-arched headers and an increasing hierarchy of fenestration is not uncommon for industrial buildings of the 1870s–1880s, the application of an external decorative scheme demonstrates that there was a clear intention to make an impression upon the streetscape.

The consistency of design and the use of repetitive details with a hierarchy of style makes it highly likely that drawings were prepared prior to the construction of both the Arundel Street and the West ranges. Their internal layout was consciously planned to accommodate the individual stages of manufacture, which resulted in a layout notably different to many of the earlier buildings. This raises the possibility that they were designed, or at least influenced, by an architect. While there is no documentary evidence for this and no direct association with an architect has been found, Beauchamp (2002) has explored the role played by architects in the design and evolution of workshops and factory structures in late 19th century Sheffield. During this period, builders proved adept at constructing a diverse range of structures that took account of the individual needs of future occupants and accommodated the requirements of the new regulations that were being introduced to control the construction of new buildings. These builders, therefore, can in many ways be regarded as practicing architect-cum-designers, although they did not necessarily regard themselves as such.

The introduction of regional legalisation was intended to have a fundamental impact upon factory design, with some of the earliest bye-laws in Sheffield being concerned

with the output of smoke. In 1853, the *Smoke Bye-Law in Pursuance of the Municipal Corporation Act* stated that 'every fire-place or furnace employed or to be employed, within the borough of Sheffield, in the working of an engine or engines by steam, shall be constructed so as to consume or burn all the smoke arising from such fire-place or furnace'. This new requirement resulted in minor adjustments to the design of chimneys, fireplaces and hearths. The height of chimneys, for example, was increased to enable the smoke to dissipate at a greater distance from the ground. The effect of these new regulations is on the whole, however, questionable, especially as the continuing use of coal and coke as a fuel would have maintained a dense smog-like atmosphere within those areas of the town where such fires were concentrated.

The introduction of local building bye-laws in the October of 1864, required that for any new construction plans had to be prepared and submitted to the Plans Sub-committee of the Highways Committee. Without approval, construction could not commence, although the extent to which accordance with this level of control was actually policed is unclear. One of the 1864 bye-laws raised the minimum room height from 8 ft to 8 ft 6 inches, but at the same time the thickness of timbers on the inside face of flues was reduced from 9 to 4½ inches; whilst this seems somewhat fool hardly, it perhaps demonstrates that the legislation was still evolving. The two purpose-built ranges at the Butcher Wheel – buildings K and L – both date from the latter part of the 19th century and appear to conform to the 1864 bye-laws. The size and strength of the two buildings, however, is such that, when compared to the smaller buildings along Brown Lane and Eyre Lane, it becomes difficult to say for certain that they were consciously designed with the new building regulations in mind.

The 1858 *Local Government Act* issued guidelines to the *Public Health Act* of 1848. These allowed the municipal corporations to issue bye-laws relating to the width and construction of streets, the structure and stability of buildings, the prevention of fire and provision for ventilation, drainage and conveyances. This appears to have had some impact at the Butcher Wheel, with the West and Arundel Street ranges being constructed with an internal brick jack-arch construction that, in addition to supporting the grinding workshops on the upper floors, also created a fireproof structure. The effectiveness of these bye-laws varied enormously: party walls, for example, were not required to continue through the roof space to prevent the spread of an outbreak of fire, as this was not in accordance with local building practices. However, the design of a central enclosed stairwell (Pl.34) in the West range with walls that continued to the underside of the rafters, does demonstrate that a degree of fire prevention was inherent in its construction. Unlike the majority of the large purpose-built cotton mills (Giles and Goodall 1992) from the late 18th–19th century, which pioneered structural designs to minimize the spread of fire, no evidence at the Butcher Wheel has been noted for firefighting equipment, such as integral hydrant systems of the type produced and supplied by Boulton and Watt (Miller and Wild 2007, 157). The brick jack-arched ceilings, therefore, may have been more of a necessity to support the weight of the grinding workshops, with fire prevention as a secondary purpose.

In the second half of the 19th century plastics, notably celluloid, were introduced for handles. Celluloid was a highly flammable material and if stored in proximity to the dust produced whist grinding could easily ignite a spark. The wheels spun in a bath of water which helped reduce sparking, but extra precautions included the physical separation of flammable materials from the grinding workshops. At the Butcher

Wheel, free-standing stores were built within the courtyard as depicted on the 1896 Goad Insurance plan (Fig.14), which noted that celluloid working was being undertaken on the upper floors of the complex; this presumably concerns the assembly of new blades and tools by the cutlers making use of celluloid, or one of its derivatives, as handles.

Working Conditions and Sanitation

The evidence for the working conditions in 19th-century factories can be partly understood from contemporary accounts, especially in the reports of the various commissions tasked with inspecting the workplace and reporting on the general conditions. Interestingly, a report by Haywood and Lee in 1848 commented favourably upon the Butcher's Arundel Street site, noting that proper structural arrangements were in place, along with appropriate levels of ventilation (Williams 2003, 123). Only limited evidence for improvements in ventilation have been recorded at the Butcher Wheel, although this may be largely because many of the features from this date have been removed or obscured by subsequent periods of alteration and change.

Sheffield was growing very quickly in the 19th century. Poverty and epidemics (especially the outbreak of cholera in 1832) demonstrated the need for sanitary reform, with middens and cesspits the only form of sewage provision. The provision for sanitation within the many manufactories in Sheffield is poorly understood, but is likely to have been equally unsatisfactory. The town council established a local Board of Health in 1865 and took over collections and disposal of refuse from ashpits and privy middens. In 1866, when there was threat of another cholera outbreak, privies were cleaned for free. In 1899, Sheffield was still regarded as a privy midden town,

with only 4,300 water closets for 320,000 people (approximately 1 for every 74 people). Sewers had still not been laid to an overall plan even though the Blackburn Meadows Sewage Works was opened in 1866. *The Sheffield Corporation Act* of 1890 empowered the council to compel people to convert middens to water closets.

No evidence survives for the provision of welfare facilities for the hundreds of workers at the Butcher Wheel in the early–mid-19th century, although it is suggested that a small number of privies would have been available in the courtyard. However, towards the end of the 19th century an impressive suite of toilets (Pl.26) was installed, which may have been partly influenced by the 1875 *Public Health Act.* In contrast, the insertion of a Bramah pan closet in the second half of the 19th century above the suite of rooms interpreted as the Director's offices was a significant undertaking. Such a luxury would have been both a considerable expense and a technological challenge, as a private water supply may have been required. The room housing the toilet was a secondary addition and over sailed a large light well concealed behind the Brown Lane frontage above building E.

One of the common forms of illness in the Sheffield grinding workshops was silicosis, or 'grinders lung' (Wray 2000, 26). The 1865 Commission Report investigated the health of the grinders and concluded that dry grinding without water caused many men to die before they reached thirty. The introduction of dust extraction systems became more common during the early years of the 20th century, although there was some resistance from the grinders. Evidence for dust collection was noted at the Butcher Wheel in the form of metal loops hung from the ceilings of many of the former workshops, which would have supported pipework and ducting for dust extractor units, or cyclones, located in the courtyard below.

Technological aspects of production

The Forges

[Plate 28]

The forging of the steel into blades for grinding was a significant aspect of the manufacturing process. Hand forges were an integral part of each range, nearly all of which were located at ground level and facing into the courtyard (Pl.28). Those along the Arundel Street and West ranges were the largest, measuring on average 14 ft 9 inches x 11 ft (4.5 m x 3.4 m). Their size is notably larger than those at contemporary sites such as the Portland Works (Giles 1999b), Stag Works (Giles 1999c) and the Beehive Works (Wray 1998a), which may reflect that they were intended for the forging of larger items, requiring a number of workers within each room. Apart from their size, they do, however, contain standard features such as a door with an adjacent window, a hearth and evidence for internal benches.

A single example of a more traditional hand forge within one of the former cart passages on Eyre Lane is a rare survival (Fig.16). It is considerably smaller than the main forges, only an eighth of the size, and slightly earlier, dating to the 1860s to 1870s. Beneath a wooden casement window, opening onto the yard, is a large stone anvil block into which the metal stiddy would have been secured. The adjacent hearth has an overhead hand-operated bellows, with a flue that has been crudely boxed in running across the ceiling. There are likely to have been more examples of this size of forge within the works, some of which may have been located on the upper floors. Evidence for hearths was located on the first floor of building C, which also had a strengthened stone floor. There is also evidence for hearths on the upper floor of the West range, although this may have been for secondary working and heating

processes associated with the assembly of knives and edge tools. Another style of forge found within Sheffield took the form of open fronted shops (Wray 2001, 50), although none have been identified at the Butcher Wheel; they seem to have been a particular feature of some of the larger integrated factories developed along the Upper Don valley, rather than in the more confined and densely packed works in the city (Wray 2000, 44).

Grinding Workshops

[Plates 29 and 30]

The best-preserved grinding workshops are in the West range, built towards the end of the 19th century. Their layout is typical, with blind rear walls and large windows facing the courtyard, although unusually they lack the provision of high level ventilation grills as the workshops back on to the walls of the Sterling Works. The windows facing the courtyard were wooden framed with rectangular lights, typical of Sheffield cutlery workshops, however, at least one window within each frame was completely removable, presumably for increased ventilation to reduce the dense atmosphere that would be generated when the workshops were fully occupied. This feature does not appear to have been recognised elsewhere (Wray 2000), although this could simply be as a result of widespread replacement of windows in contemporary workshops elsewhere.

Power was provided via rotating wooden drums along the back wall, with leather belts connected to each individual grinding wheel (Pl.29). The earlier troughs were supported by a wooden superstructure positioned above a sloping brick channel that allowed the belts to rotate freely. The grinding stones were housed in riveted metal troughs, one of which was recovered from beneath the later concrete floor of the

earlier Arundel Forge (building G). The secondary glazing wheels set behind the grinding stones did not require such a substantial trough, and simply spun within the wooden framework (Fig.24).

Power Systems

The requirement for mechanised power was restricted to selected processes at the Butcher Wheel, including the operation of the grinding wheels and for buffing and polishing finished items. Whilst this conforms to the general pattern of cutlery and edge tool manufactories in Sheffield, its introduction to the Butcher Wheel was unlike both the purpose-built public wheels and contemporary works of a similar size, which had workshops of standardised sizes and equally distributed power transmission. Rather, the gradual expansion of the Butchers landholding between Eyre Lane and Arundel Street resulted in a power system which grew organically.

Whilst it was possible for the Butchers to make extensive use of water power at their rolling and tilt works at the Philadelphia Works located on the River Don (Fig.1), this was not an option at the Arundel Street site. When they initially occupied a few workshops on Eyre Lane it is likely that power was generated for individual processes via a treadle wheel, or leg frame (Beauchamp 2002, 96). However, as the site developed the introduction of steam power became inevitable (Williams 2003, 122), especially following the acquisition of the Arundel Forge on the corner of Brown Lane and Arundel Street in the 1850s. This existing works had a two storey grinding range backing on to Brown Lane (building G), with power provided by an integrated steam engine at its south end with an output of 8 horsepower. Structural evidence in the form of cast-iron beams and possible mounting blocks for an engine was recorded at the base of the stairwell in building H; although, due to the later alteration of

building G, there was insufficient evidence to provide specific details of its original form or manufacturer, this is likely to have been a beam engine (Giles and Goodall 1992, 136).

Following the remodelling of the site in the second half of the 19th century, the multi floored grinding workshops in the West range and on all of the upper three floors of building M on Eyre Lane would have required an increase in the amount of power available on the site. This was achieved by the introduction of two new steam engines in opposing corners of the yard, most likely utilising horizontal engines. The south-east room in the Arundel Street range still retains a few elements characteristic of 19th-century engine houses (Giles and Goodall 1992, 142–145), including wooden vertical planking on the walls, which was originally stained and varnished; large round-headed windows with restrained external ornamentation; high ceilings; decorative plaster cornices; metal ceiling vents and drive shaft mountings; and wall boxes to deliver the power throughout the complex. To the north-west, in building M, only a massive sandstone block that may have formed part of the mount for a flywheel remained.

Steam to power the stationary engines in the two engine houses was provided by large cylindrical Lancashire Boilers positioned in the south-east section of the courtyard (Fig.14), the exhaust gases from which would have been channelled via underground flues to the 120 ft (36.8 m) high central chimney in the courtyard. The Goad plan (Fig.14) depicts a second, square chimney 50 ft (15.25 m) high on the east side of the cart passage through the Arundel Street range, which was subsequently converted to a goods lift. This chimney would have projected though the building and may have pre-dated its construction, perhaps being associated originally with the Arundel Forge.

The Goad plan (Fig.14) details the site of a third engine mid-way along the courtyard elevation of the West range. The details of this are unknown. However, its proximity to the vertical cast-iron brackets attached to the second floor courtyard elevations, for the lifting of grinding wheels and heavy goods, may be significant, and the installation of a small engine in this location can be interpreted as having powered the lifting wires/ropes.

[Plate 31]

Power was transferred throughout the works via belt drives and line-shafting, although none remained *in situ* (Pl.31). Evidence in the form of overhead mounting brackets and metal plummer-blocks, was noted in all of the ranges, demonstrating that power was required in not just the grinding workshops, but for ancillary processes as well. Power drives were commonly located underneath the wooden work benches, but their removal from the various cutlers and assembly workshops on the upper floors of the Arundel Street range and West range makes their exact layout a matter of conjecture. Unlike the normal practice of running power transmission along the rows of internal cast-iron columns (Giles and Goodall 1992, 68–9), none of the columns in the Butcher Wheel had any attached or cast bolting heads for supporting this method of overhead transmission.

Integrated within many of the brick jack-arch ceilings are small rectangular slots with wooden linings. These acted as belting slots to transfer power vertically between each floor. In addition, along the rear of the larger grinding workshops, such as on the upper floors of the West range, deep recessed channels contained linear sections of line shafting, which supported large wooden drums that directly transferred the power to each grinding, or glazing wheel. The danger of the numerous rotating belts was

minimised by concealing them beneath wooden planks on each of the grinding troughs, and in wooden boxes attached to the walls; nonetheless, the risk of injury in areas of exposed belting would have been high.

[Plate 32]

The introduction of electricity in the first quarter of the 20th century dramatically changed the operation of the works. The steam engines and boilers became redundant and were replaced with two brick-built electricity houses, buildings P and Q, built on either side of the courtyard. It is, however, likely that the pre-existing line-shafting and belt drives continued to be operated, even though at this time the addition of individual motors at strategic locations throughout the works would have provided the motive power. The remains of floor-mounted concrete blocks with fixings for electric motors were recorded on the first and second floors of the West range (Pl.32). However, these may be slightly later in date and follow the removal of the large, multi-occupancy wooden framed grinding troughs on the second floor of the West range.

Chapter 5 – Conclusions

The Butcher Wheel is perhaps the best preserved example of a courtyard works within the centre of Sheffield. It demonstrates the gradual growth of a flourishing Sheffield cutlery and edge tool business with origins at the start of the 19th century and growing to be one of the principal manufactories in Sheffield. The buildings span six original building plots within what was proposed as a high-class residential suburb on the estate of the Duke of Norfolk. The failure of this residential scheme is evident in the piecemeal growth and expansion of the Butcher Wheel and neighbouring sites along Arundel Street, and is testament to how the grand vision of the Duke of Norfolk was subordinated to the industrial development of Sheffield.

The origins of grinding workshops as independent buildings located along the many river valleys of Sheffield (Ball *et al*. 2006) is one of the principal factors that made Sheffield the dominant producer of cutlery in the 18th and 19th centuries. The expansion of the trade into the urban districts following the introduction of steam power (see Williams 2003) allowed the grinding process to develop. One of the new aspects of urban grinding was the introduction of 'public grinding wheels'. The earliest of these were the Soho Wheel and Union Wheel, both located in the north-east of Sheffield between West Bar and the River Don, where steam was used to power rows of workshops with shared power drives, arranged over two floors (Wray 2000, 28).

This arrangement of workshops with rows of parallel grinding troughs on multiple floors and powered by a shared drive is one of the principal characteristics of the Butcher Wheel. This is a unique feature of the Sheffield trade and contemporary examples where this arrangement can still be found are the Sellers Wheel on Arundel

Street (Giles 1999d; ARCUS 2009b), the Globe Works on Penistone Road (Wray 1998b), the Portland Works on John Street (Giles 1999b), the Baltic Works on Effingham Road (Wray 2000, 31) and the Beehive Works on Milton Street (Wray 1998a). Many more works would undoubtedly have utilised this layout, but their subsequent adaptation and the extensive clearance of many cutlery sites during the 20th century have resulted in this industrial form of workshop now being regarded as unusual.

The archaeological recording of the Butcher Wheel has successfully unravelled a complex sequence of structural development, which grew from a group of four back-to-back houses on the corner of Brown Lane and Eyre Lane and adjacent two-storey workshops. This gradual expansion and inter-connectivity between separate buildings was not unusual in Sheffield, however the lack of available land for expansion is evident from the addition of multiple storeys. This is most notable along the Eyre Lane façade (Fig.16), and in building G, the former Arundel Forge, where two successive campaigns of building changed the structure from two, to three and finally to four-storeys in height.

After acquisition of the last of the southerly plots and construction of the Arundel Street range, the consolidated works presented a unified frontage and access was re-orientated away from Eyre Lane, where all of the former entrances had been in-filled and converted to additional workspace and a caretaker's house. These older parts of the works had reached a practical limit for expansion, so subsequent development took the form of a final large purpose-built four-storey range along the west boundary with the Sterling Works. This building utilised a brick jack-arch structure, as

previously used in the construction of the two-storey grinding workshop of the Arundel Forge that backed on to Brown Lane.

The redevelopment of the site provided a unique opportunity to examine in detail a selection of these upper floor grinding workshops. The excavation and clearance of the grinding troughs has provided a much greater understanding of not only the structural form, but the power mechanisms used to power the multiple wheels and line shafts. Three principal designs of trough were identified: either made from riveted steel sheets; brick and timber structures recessed within the floor; or free standing concrete troughs. As a testament to the importance of this style of upper floor workshop, the best preserved example within the West range has been retained as a public museum with interpretation boards that help explain the history and operation of the various workshops and the history of the Butcher Wheel (Pl.33).

[Plate 33]

The change in style of trough appears to be directly associated with the shift from steam powered grinding, to electric powered motors. The Butcher Wheel retains evidence for both forms of power, although the electric motor houses were removed as part of the redevelopment.

The continuation of use of the ground floor workshops of the Butcher Wheel by the Freeman College as artisan workspaces, for teaching craft skills and silversmiths, must be regarded as the best outcome for the site. The redevelopment has been successful in securing a future for a rambling complex of redundant industrial buildings, whilst maintaining a continuum of the use of the site for the Sheffield metal trades in to the 21st century.

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Appendix

Technical glossary

Annealing	The process of heating and cooling blanks of metal to remove internal stresses by altering the mechanical, or physical properties and produce a consistent microstructure
Blister steel	Product of a cementation furnace – steel bar with surface 'blisters'
Buffing/polishing	A finishing process using a cloth wheel dressed with a fine abrasive
Cool trough	Trough containing water and/or oil for quenching blades during hardening
Cementation	Process of converting wrought iron into steel by packing iron bars with charcoal and heating in an enclosed chest for several days within a conical cementation furnace
Crucible steel	Homogeneous steel produced by melting broken up pieces of blister steel bar in a crucible in a furnace
Flatstick	Shaped piece of wood with which the grinder presses the blade to the wheel allowing greater control of the artefact
Flatware	Forks and spoons
Forging	Hammering heated steel into the shape of a blade
Glazing wheel	Leather covered wheel, being coated with emery powder to give a fine finish to polished blades
Grinding	Using an abrasive wheel to put a sharp edge on a blade
Hackhammer	Chisel-faced hammer to correct defects in the surface of a grindstone
Horsing(g)/saddle	Wooden seat that straddles a grinding trough
Hull	The building housing the troughs (trows), grinding wheels, drive belts and seating
Little Mester	An individual craftsman, with perhaps two or three employees, using his own workshop or room and power in a larger building
Racing iron	Tool to enable the grinder to true up his stone after use had made it uneven and no longer circular
Shear steel	Blister steel bars, layered, heated and hammered to make a more homogeneous steel
Stiddy (stithy)	An anvil made from metal
Stock	Wooden or stone base for an anvil
Swarf	Small wet pieces of metal and stone thrown off when grinding

Taking-in door	An access doorway to facilitate the movement of goods, or materials either in to, or out of a building, usually associated with a manufacturing process, or storage facility such as a warehouse
Tenement factory	A building where cutlery manufacture could be carried out by individual ‘little mesters’, but where they could rent a room, or a grinding wheel, and use a centrally-provided power source
Trow	Grinding wheel, water trough and seat (or saddle)

Figure 1: Site location map showing the Cultural Industries Quarter and key sites

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Figure 2: Extract from 1808 Fairbank plan of Alsop Fields © Sheffield Archives

Figure 3: Site layout

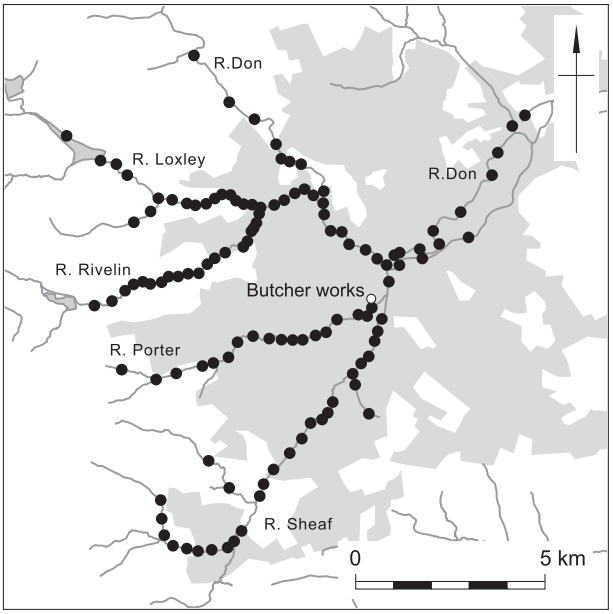

Figure 4: Map of Sheffield water powered sites, redrawn from Water Power on the Sheffield Rivers (Ball et al. 2006, xix)

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Figure 5: Layout of a grinding hull (reproduced from Taylor 1879), reproduced with permission from Sheffield City Council, Libraries Archives and Information: Sheffield Archives

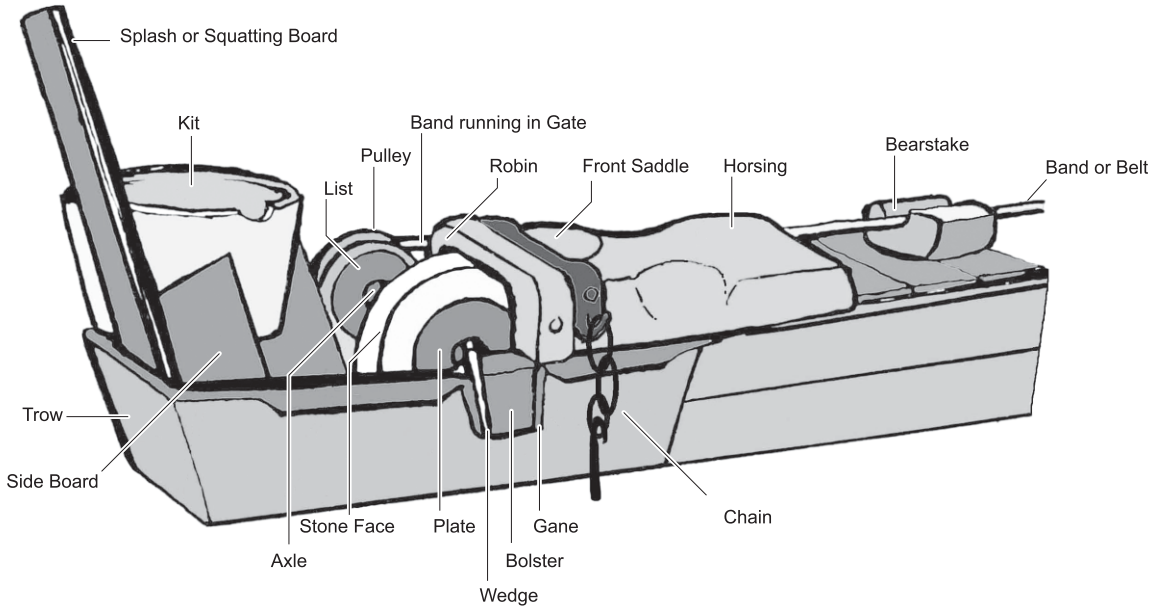

Figure 6: Parts of a grinding trough

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Figure 7: Extract from Fairbank rate book 1836 © Sheffield City Council, Libraries Archives and Information: Sheffield Archives FC/MB/398

Figure 8: Trade advert illustration Eyre Lane frontage © Sheffield Library

Figure 9: Export trade label from Fawcett's scrapbook, 1836 © Sheffield City Council, Libraries Archives and Information, Local Studies reference William Fawcett's Scrapbook, 082.2 SSTQ

Figure 10: Wade and Butcher printed wrapper © Museums Sheffield

Figure 11: Trade advert in foreign buyers catalogue, 1895, reproduced with permission from Geoff Tweedale

Figure 12: Phased development plans of the Butcher Wheel

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Figure 13: Extract from 1850 Ordnance Survey Map 26” to 1 mile, reproduced with permission from Sheffield Archives Ordnance Survey Map Collection

Figure 14: Extract from 1896 Goad Insurance Plan © Sheffield City Council, Libraries Archives and Information: Sheffield Archives SY674/24

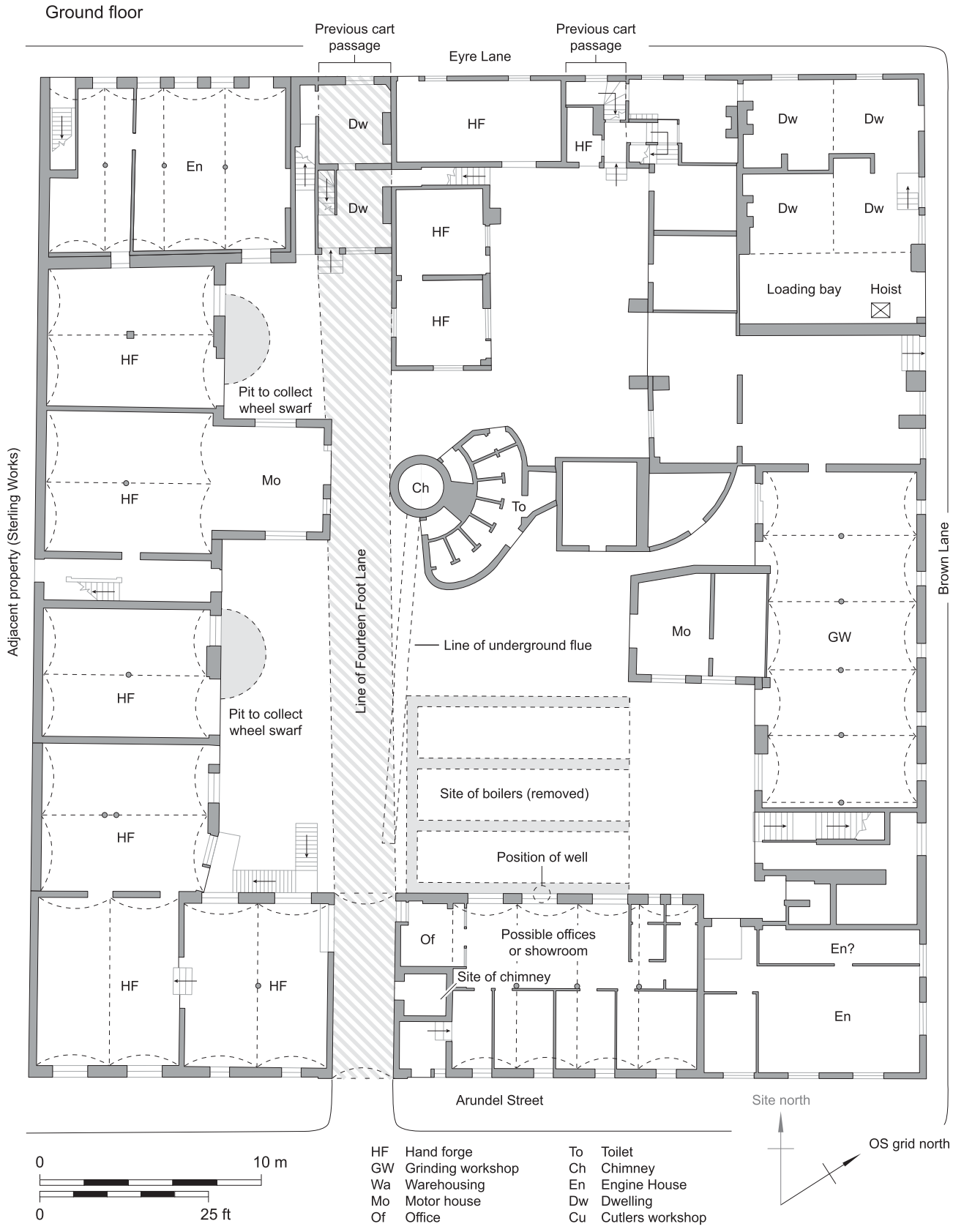

Figure 15: Courtyard and ground floor plan

Figure 16: Phased development of Eyre Lane façade

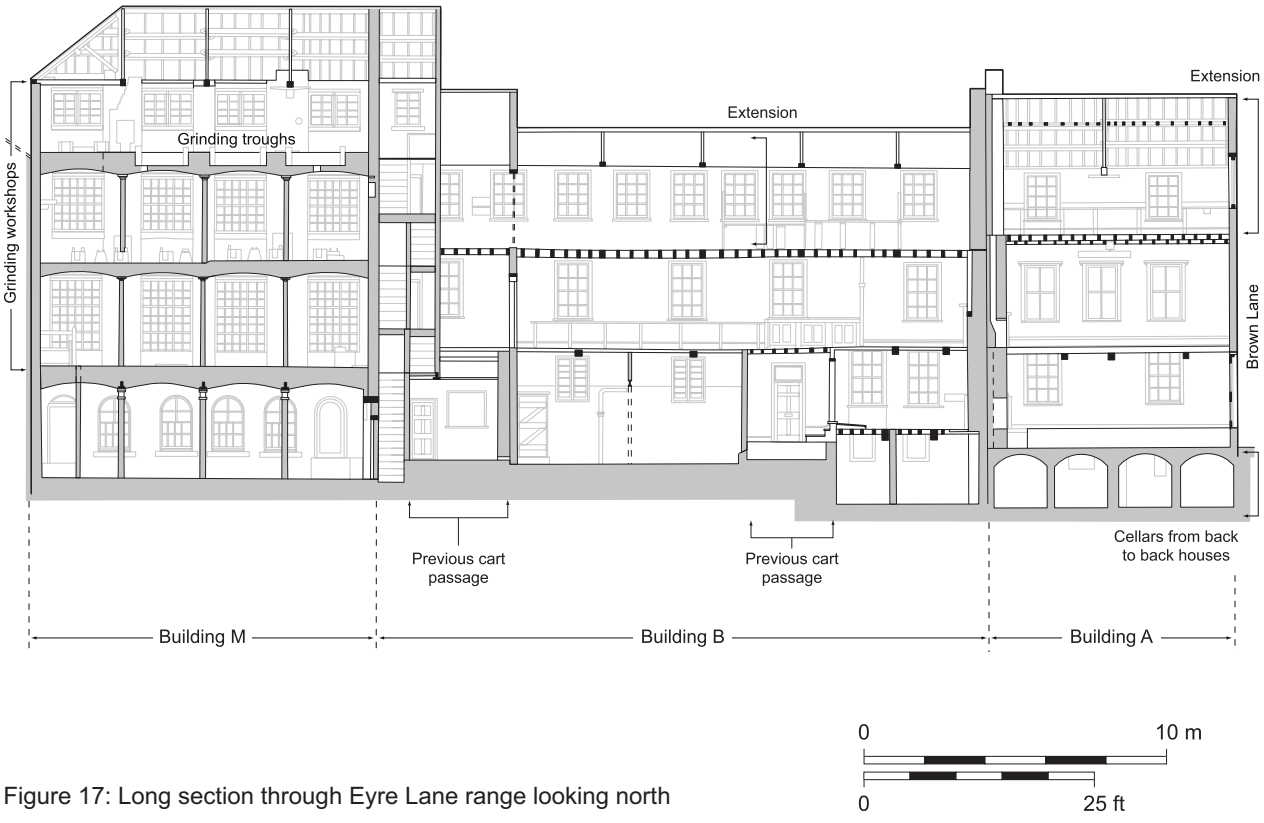

Figure 17: Long section through Eyre Lane range looking north

First floor

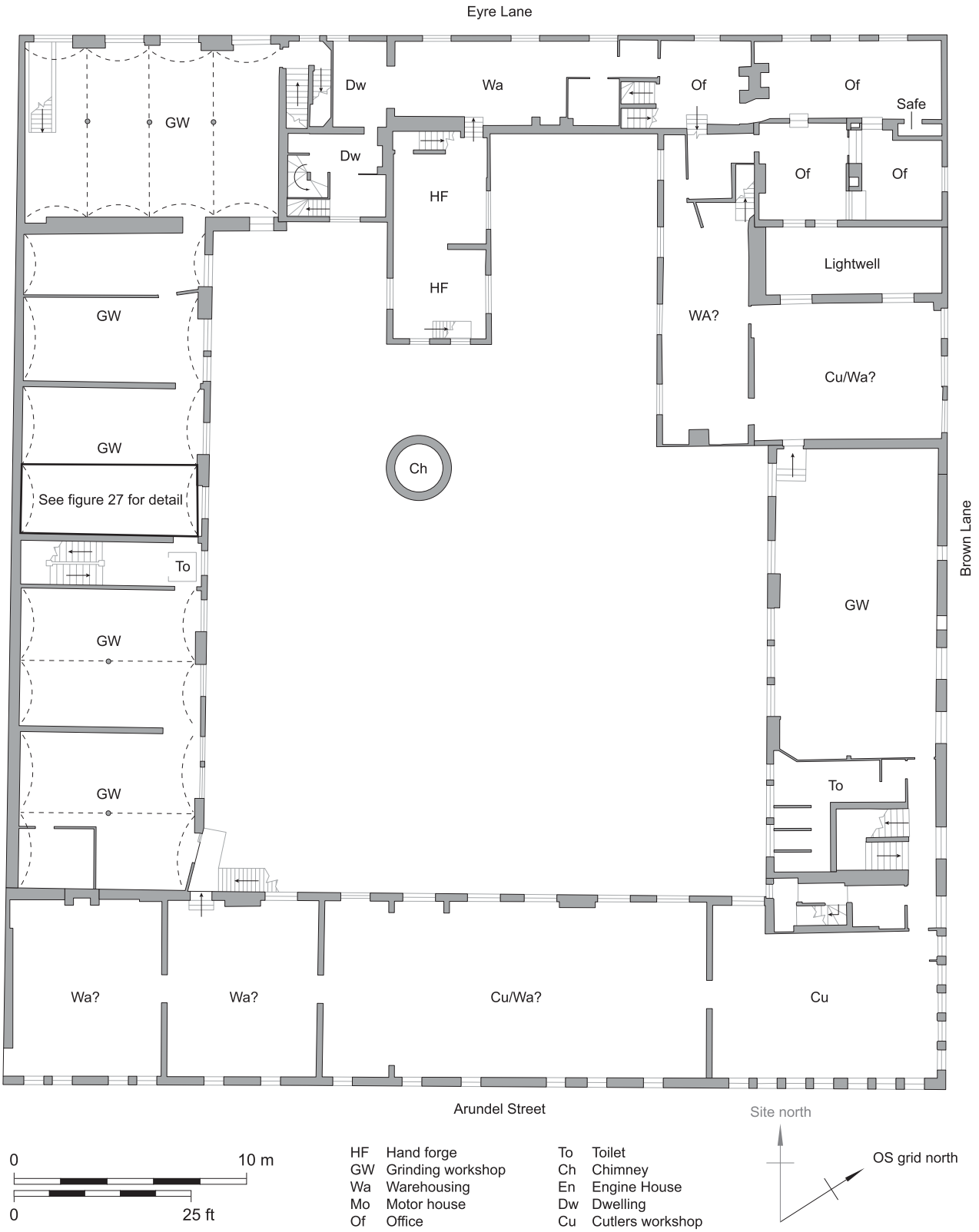

Figure 18: First floor plan

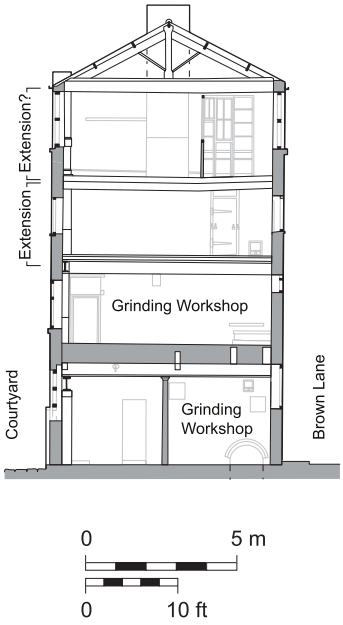

Figure 19: Cross section through Brown Lane range (former Arundel Forge)

Second floor

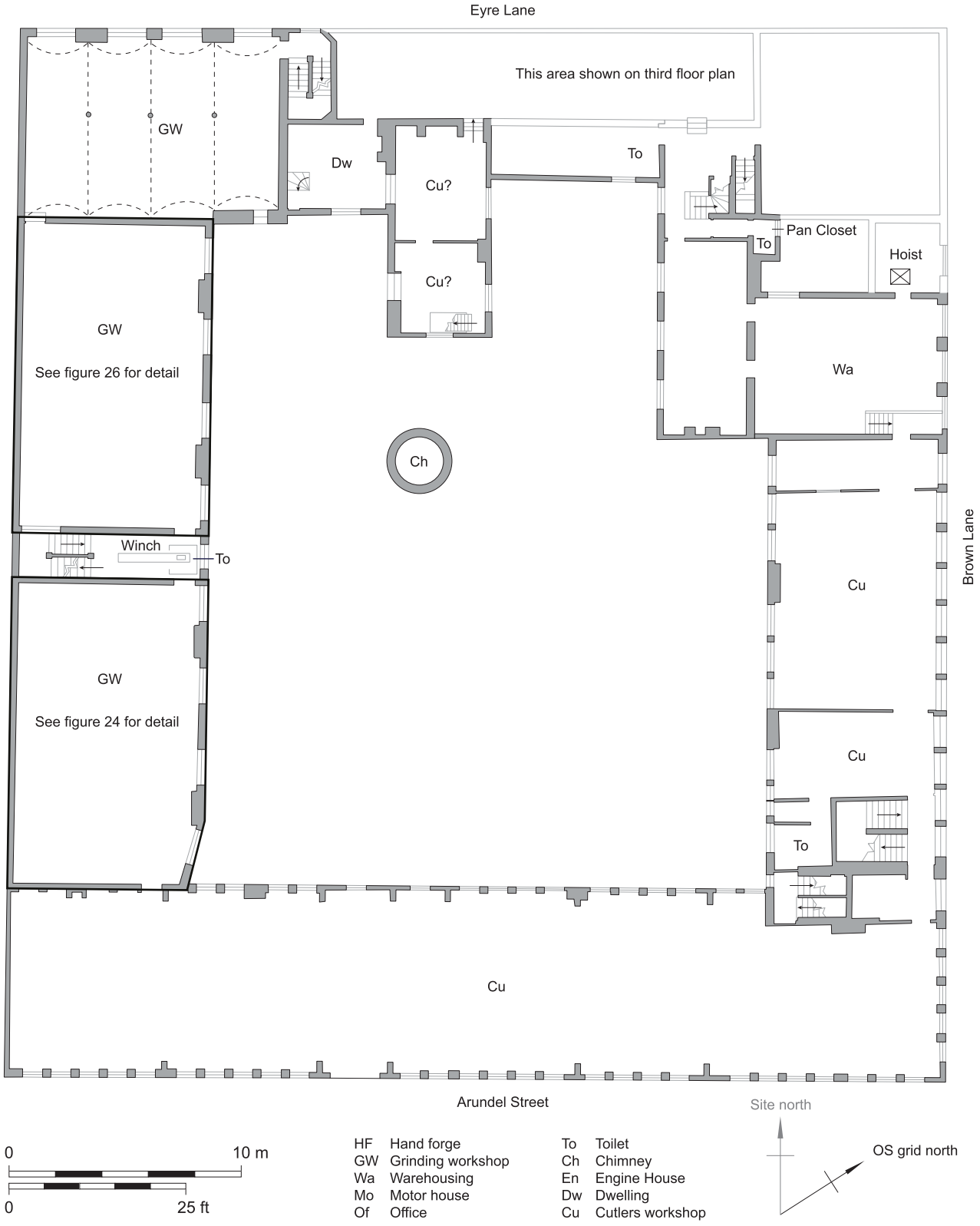

Figure 20: Second floor plan

Third floor

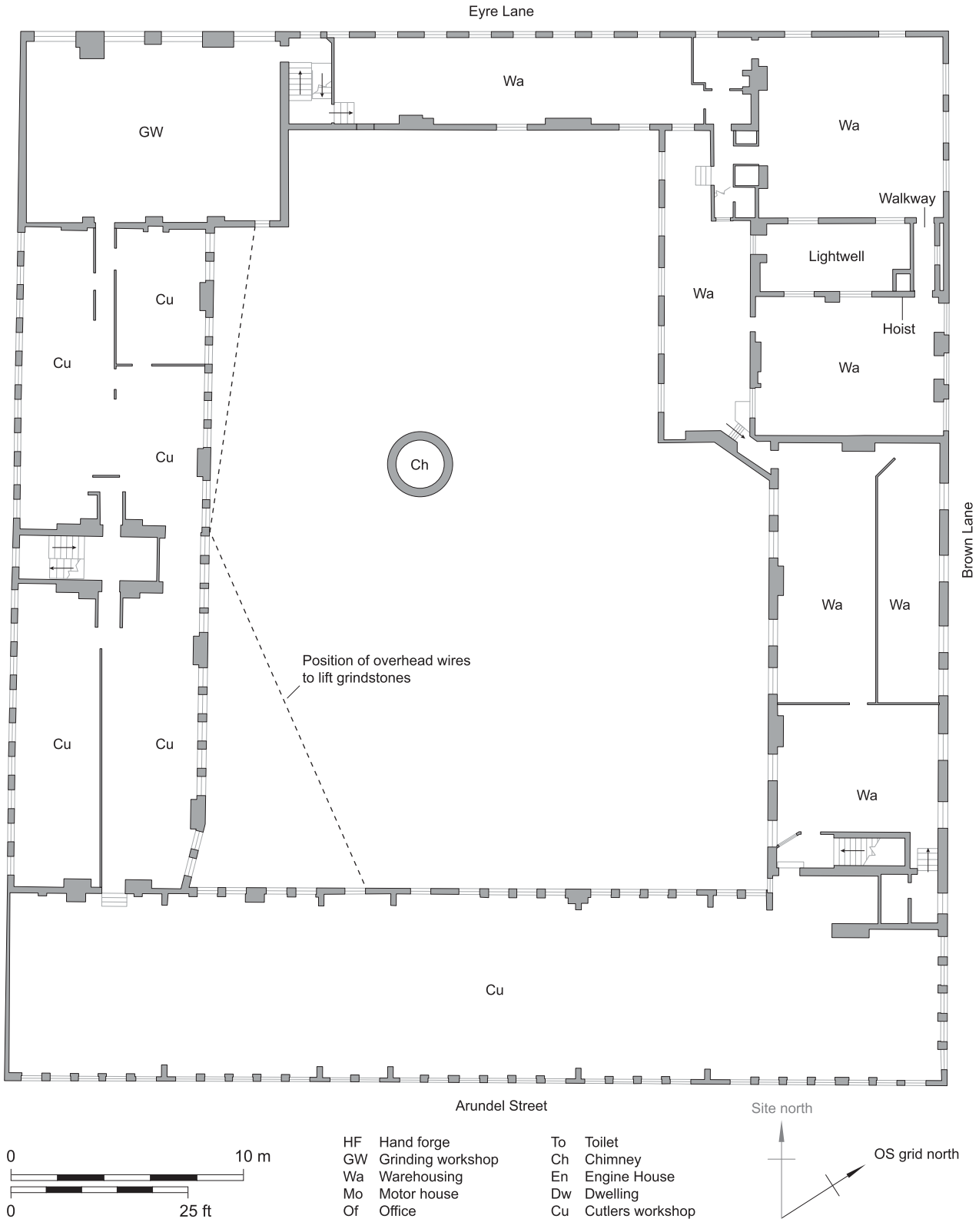

Figure 21: Third floor plan

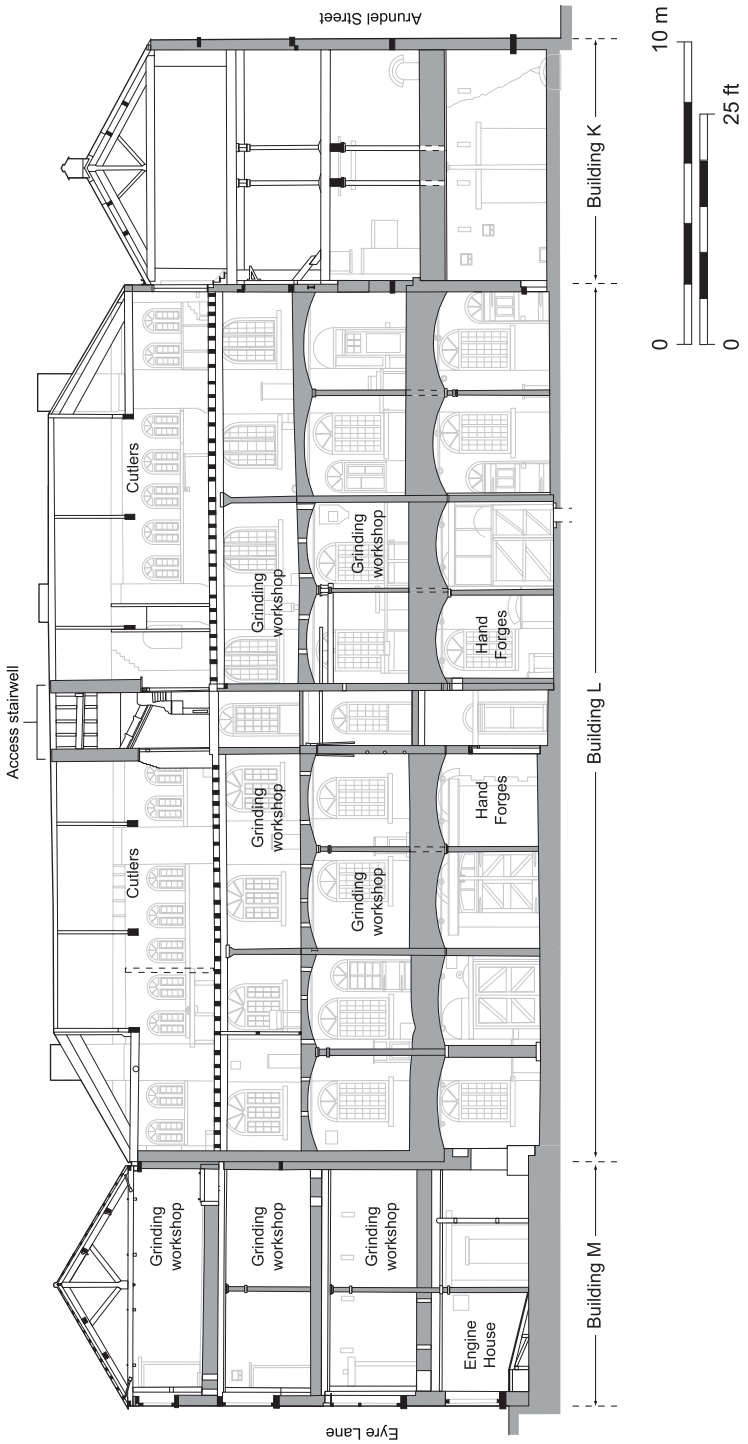

Figure 22: Long section through West range, looking east

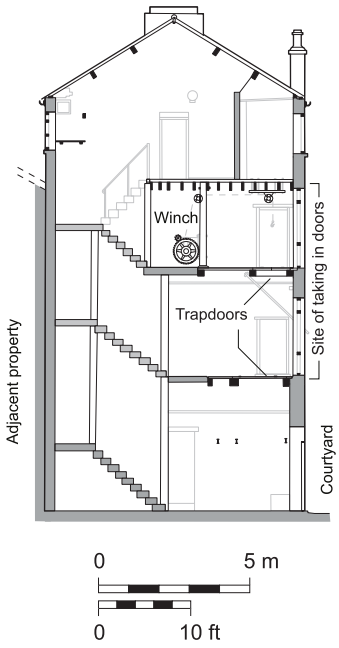

Figure 23: Cross section through central stairwell of West range, looking north

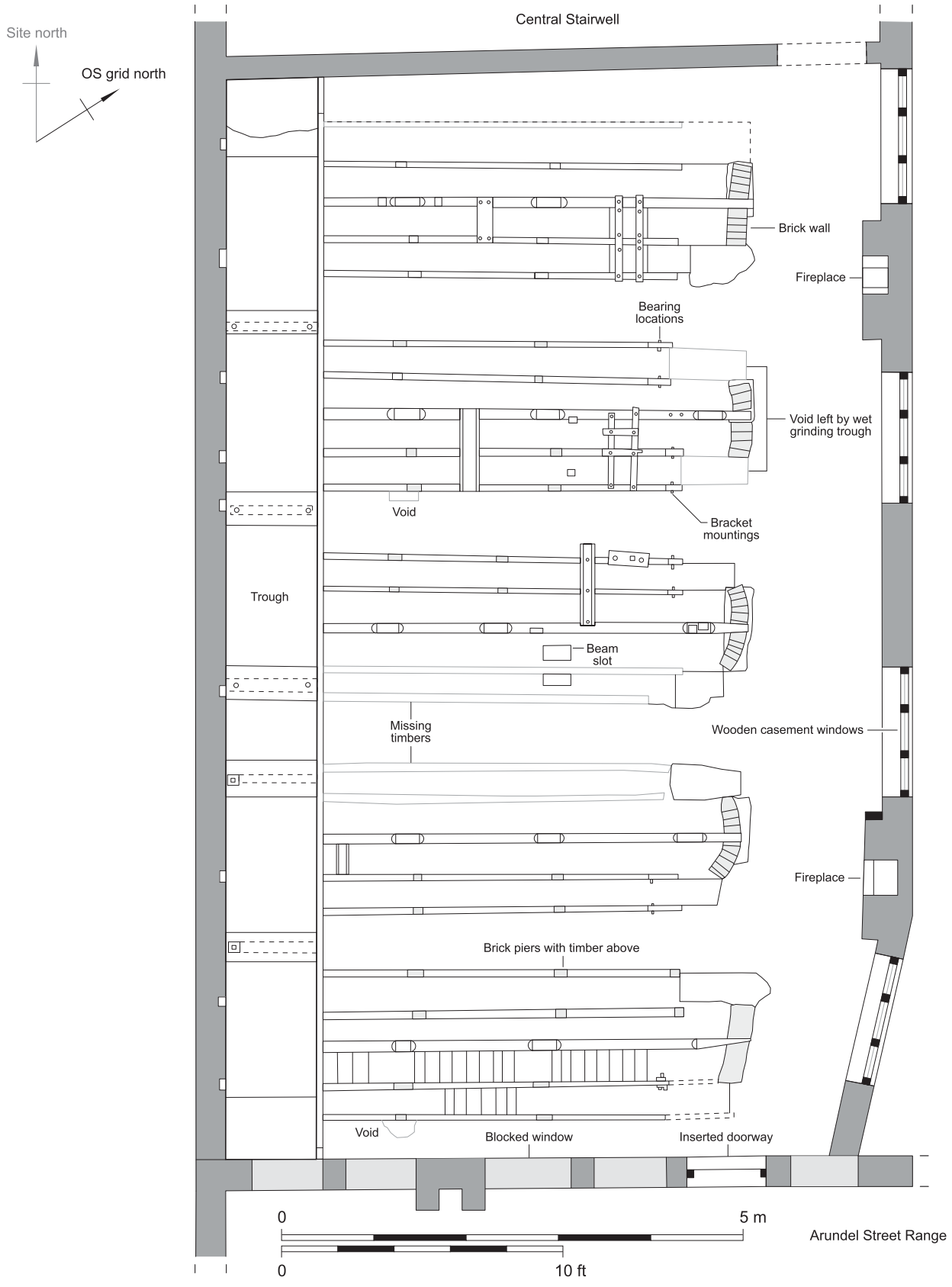

Figure 24: Floor plan of south grinding workshop with wooden troughs, second floor, West range

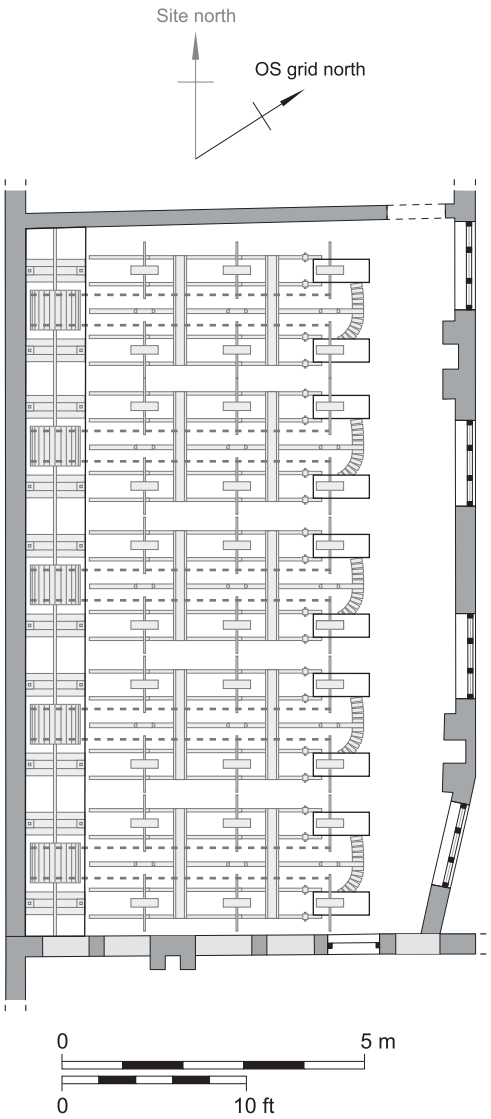

Figure 24b: Floor plan of south grinding workshop showing operation of grinding equipment, second floor, West range

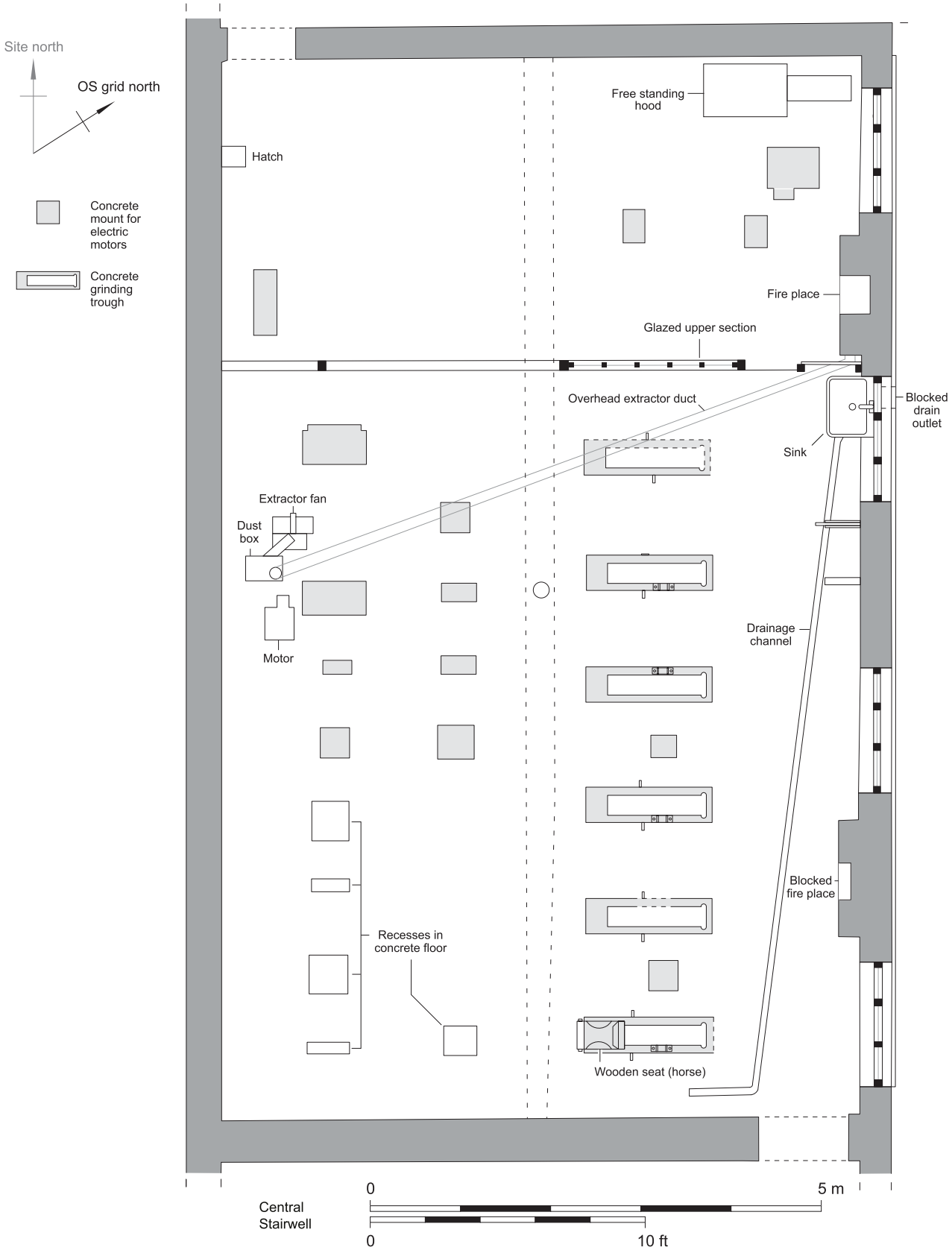

Figure 25: Floor plan of north grinding workshop with concrete troughs, second floor, West range

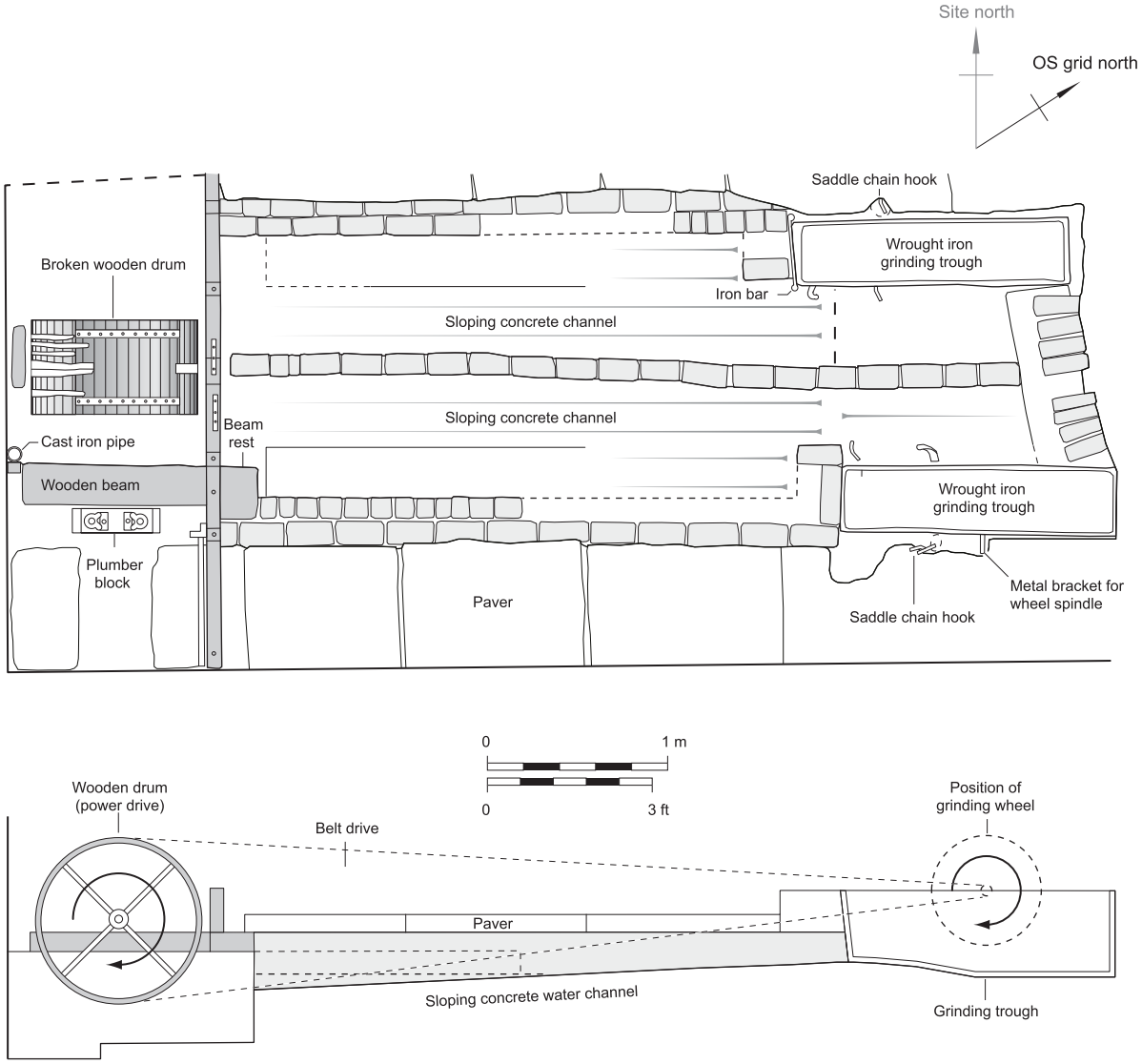

Figure 26: Plan and reconstruction section through first floor grinding trough, West range

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